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Abundance and Distribution of the Chinook Salmon Escapement on the Alsek River, 2002

by

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and

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September 2003

Alaska Department of Fish and Game

Division of Sport Fish

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

all commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
all commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
and	&
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
id est (that is)	i.e.,
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	F, t, χ^2, etc.
confidence interval	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	log_2, etc.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
standard length	SL
total length	TL
variance	var

FISHERY DATA SERIES NO. 03-20

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by

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ABSTRACT

The abundance and distribution of chinook salmon *Oncorhynchus tshawytscha* returning to spawn in the Alsek River in 2002 was estimated with radiotelemetry and a mark-recapture experiment conducted by the Alaska Department of Fish and Game, the Canadian Department of Fisheries and Oceans, and the Champaign/Aishihik First Nation. Age, sex, and length compositions for the immigration were also estimated. Set gillnets fished near the mouth of the Alsek River during May, June, and July, 2002 were used to capture 582 large (≥660 mm MEF) immigrant chinook salmon, 552 of which were marked with individually numbered spaghetti tags, a hole punched in their left opercle, and removal of an axillary appendage; 195 also had radio transmitters inserted into their stomachs. In addition, 88 medium (440–659 mm) fish were marked. During July and August, chinook salmon were captured at spawning sites and inspected for marks. We used a modified Petersen model to estimate that 8,807 (SE = 623) large chinook salmon immigrated into the Alsek River above Dry Bay. Canadian fisheries on the Tatshenshini River harvested an estimated 303 large chinook salmon, leaving an escapement of 8,504 large fish. We used a proportional model to estimate that 9,510 (SE = 717) chinook salmon of all sizes immigrated into the Alsek River above Dry Bay. About 24% of the total estimated spawning escapement of large fish in the Alsek River (2,067 chinook salmon) were counted at the Klukshu River weir. The radiotelemetry study estimated about 31% of the escapement was bound for the Klukshu River.

An estimated 6.2% of the Alsek River escapement were age -1.2, 56.2% age -1.3, and 35.8% age -1.4, with 272 males and 305 females sampled.

Key words: chinook salmon, *Oncorhynchus tshawytscha*, Alsek River, Klukshu River, Tatshenshini River, mark-recapture, radiotelemetry, escapement, abundance

INTRODUCTION

The Alsek River originates in the Yukon Territory, Canada, and flows in a southerly direction into the Gulf of Alaska, southeast of Yakutat, Alaska (Figure 1). Chinook salmon *Oncorhynchus tshawytscha* returning to this river are caught primarily in commercial and subsistence set gillnet fisheries in the lower Alsek River and in recreational and aboriginal fisheries on the upper Tatshenshini River in Canada (Tables 1, 2). Small harvests of this stock are also probably taken in marine recreational and commercial set gillnet and troll fisheries near Yakutat. Exploitation of this population is managed jointly by the U.S. and Canada through a subcommittee of the Pacific Salmon Commission (PSC) as part of the U.S./Canada Pacific Salmon Treaty (PST) adopted in 1985 (TTC 1999).

Counts of chinook salmon spawning in tributaries of the Alsek River have been collected since 1962 (Table 3). Since 1976, the Canadian Department of Fisheries and Oceans (DFO) has operated a weir at the mouth of the Klukshu River to count chinook, sockeye *O. nerka*, and coho salmon *O. kisutch*. The weir count is used as the index for the Alsek River. Mark-recapture studies in 1997–2001 indicate that Klukshu River chinook salmon account for between 15 and 20% of the total run (Pahlke et al 1999; Pahlke and Etherton 2001a; 2001b; Pahlke and Etherton 2002). Prior to 1997, the proportion of the total chinook salmon escapement to the Alsek River drainage counted at the Klukshu River weir was unknown. The U.S. used a weir expansion of 1.56 (64%) to estimate total Alsek River chinook escapement, while Canada used an expansion of 2.5 (40%) (Pahlke 1997). A recent analysis of the biological escapement goal for Klukshu River chinook salmon used a range of 30% to 100%. A biological escapement goal (BEG) range of 1,100 to 2,300 chinook salmon spawners in the Klukshu River was recommended (McPherson et al. 1998). In 1991, the Transboundary River Technical Committee of the PSC recommended that an expansion factor not be adopted due to the lack of applicable studies (TTC 1991). Annual spawning escapements of chinook salmon in the Klukshu River system have been estimated annually by subtracting from the weir count: (1) harvests taken upstream of the weir site

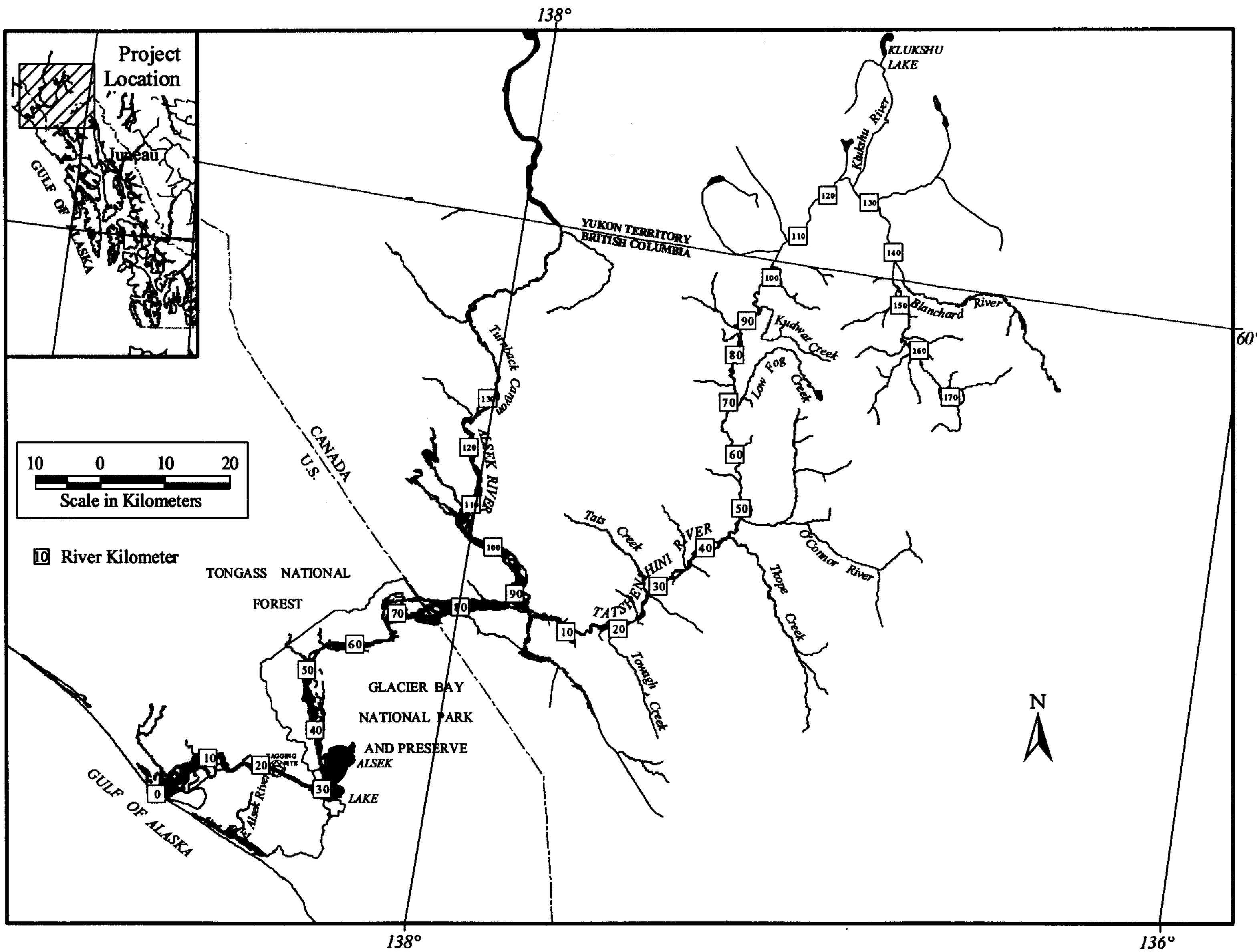

Figure 1.–Alsek River drainage, showing principal tributaries and river kilometers.

Table 1.–Estimated harvests of chinook salmon in Canadian Alsek River fisheries, 1976–2002.

	Klukshu River aboriginal fishery			Canadian sport fishery			
Year	Below weir	Above weir	Total	Dalton Post	Blanchard River	Takhanne River	Total
1976	0	150	150	130	45	25	200
1977	0	350	350	195	67	38	300
1978	0	350	350	195	67	38	300
1979	0	1,300	1,300	422	146	82	650
1980	0	150	150	130	45	25	200
1981	0	150	150	150	200	50	400
1982	0	400	400	183	110	40	333
1983	0	300	300	202	60	50	312
1984	0	100	100	275	125	50	450
1985	0	175	175	170	20	20	210
1986	0	102	102	125	20	20	165
1987	0	125	125	326	113	63	502
1988	0	43	43	249	87	48	384
1989	0	234	234	215	75	41	331
1990	0	202	202	468	162	91	721
1991	268	241	509	384	29	17	430
1992	60	88	148	79	6	18	103
1993	88	64	152	170	25	42	237
1994	190	99	289	197	69	38	304
1995	320	260	580	601	330	113	1,044
1996	233	215	448	423	78	149	650
1997	72	160	232	195	69	34	298
1998	154	17	171	112	43	20	175
1999	211[a]	27	238	122	38	14	174
2000	21[b]	44	65	24	46	2	72
2001	25	87	112	83	18	11	112
2002	20	100	120	143	31	9	183

[a] Includes 8 fish harvested from Village Creek.

[b] Includes 4 fish harvested from Village Creek and 3 from Blanchard River.

in an aboriginal fishery and; (2) in a sport fishery (1976–1978 only); and (3) brood stock removed at the weir site.

The Alaska Department of Fish and Game (ADF&G) has counted spawning chinook salmon from helicopters since 1981 and earlier from fixed-wing aircraft. Escapement to the Klukshu River is difficult to count by aerial, boat or foot surveys because of deep pools and overhanging vegetation. However, surveys of the Klukshu River are conducted periodically to provide some continuity in the database in the event that funding for the weir is discontinued. The Blanchard and Takhanne rivers and Goat Creek, three smaller tributaries of the Tatshenshini River, are also surveyed annually, but counts from these surveys are not used to index escapements.

Only large (typically age-.3, -.4, and -.5) chinook salmon ≥660 mm mideye-to-fork length (MEF) are counted during aerial or foot surveys. No attempt is made to accurately count small (typically age-.1 ≤439 mm MEF) or medium (440–659 mm and age-.2) chinook salmon. These chinook salmon, also called jacks, are primarily males that are considered to be surplus to spawning needs (Mecum 1990). They are easy to separate visually from their older, larger counterparts under most conditions, because of their shorter, compact bodies and lighter color. They are, however, difficult to distinguish from other smaller species such as sockeye salmon.

In 1997, ADF&G, in cooperation with DFO, instituted a project to determine the feasibility of a mark-recapture experiment to estimate abundance

Table 2.–Annual harvests of chinook salmon in the U.S. Alsek River commercial and subsistence/personal use gillnet fisheries, 1941–2002.

Year(s)	Commercial harvest	Year(s)	Commercial harvest	Subsistence/ personal use
1941	3,943	1971	1,222	
1942	0	1972	1,827	
1943	0	1973	1,757	
1944	2,173	1974	1,162	
1945	6,226	1975	1,379	
1941–1945 Average	2,468	1971–1975 Average	1,469	
1946	1,161	1976	512	
1947	266	1977	1,402	
1948	853	1978	2,441	
1949	72	1979	2,525	
1950	unknown	1980	1,382	
1946–1949 Average	588	1976–1980 Average	1,652	
1951	151	1981	779	
1952	2,020	1982	532	
1953	1,383	1983	93	
1954	1,833	1984	46	
1955	2,883	1985	213	
1951–1955 Average	1,654	1981–1985 Average	333	
1956	3,253	1986	481	22
1957	1,800	1987	347	27
1958	888	1988	223	13
1959	969	1989	228	20
1960	525	1990	78	85
1956–1960 Average	1,487	1986–1990 Average	271	38
1961	2,120	1991	103	38
1962	2,278	1992	301	15
1963	131	1993	300	38
1964	591	1994	805	60
1965	719	1995	670	51
1961–1965 Average	1,168	1991–1995 Average	436	34
1966	934	1996	771	60
1967	225	1997	568	38
1968	215	1998	550	63
1969	685	1999	482	44
1970	1,128	2000	677	45
1966–1970 Average	637	1996–2000 Average	609	50
		2001	541	19
		2002	700	60

of chinook salmon spawning in the Alsek River drainage (Pahlke and Etherton 2002). The results of the feasibility project were encouraging, and in 1998 a revised, expanded mark-recapture study was conducted along with a radiotelemetry study to estimate spawning distribution (Pahlke et al. 1999). From 1999 to 2001 the project has continued without the radiotelemetry study. In 2002 the radiotelemetry study was conducted again. The 2002 study had three objectives: (1) to estimate the abundance of large (≥660 mm MEF) spawning chinook in the Alsek River; (2) estimate

Table 3.–Escapement of chinook salmon to the Klukshu River and counts of spawning adults in other tributaries of the Alsek River, 1965–2002.

Year[a]	Klukshu River							Blanchard River		Takhanne River		Goat Creek	
	Aerial count		Weir count	Above-weir harvest			Escape-ment [b]						
				AF	Sport	Brood							
1965	100		–	–	–		100	100		250		–	
1966	1,000		–	–	–		1,000	100		200		–	
1967	1,500		–	–	–		1,500	200		275		–	
1968	1,700		–	–	–		1,700	425		225		–	
1969	700		–	–	–		700	250		250		–	
1970	500		–	–	–		500	100	(F)	100		–	
1971	300	(A)	–	–	–		300	–		205	(F)	–	
1972	1,100		–	–	–		1,100	12	(A)	250		38	(F)
1973	–		–	–	–		–	–		49	(A)	–	
1974	62		–	–	–		62	52	(A)	132	(F)	–	
1975	58		–	–	–		58	81	(A)	177	(A)	–	
1976	–		1,278	150	64		1,064	–		38	(F)	16	(F)
1977	–		3,144	350	96		2,698	–		38	(F)	–	
1978	–		2,976	350	96		2,530	–		50	(F)	–	
1979	–		4,404	1,300	0		3,104	–		–		–	
1980	–		2,673	150	0		2,487	–		–		–	
1981	–		2,113	150	0		1,963	35	(H)	11	(H)	–	
1982	633	N(H)	2,369	400	0		1,969	59	(H)	241	(H)	13	(H)
1983	917	N(H)	2,537	300	0		2,237	108	(H)	185	(H)	–	
1984	–		1,672	100	0		1,572	304	(H)	158	(H)	28	(H)
1985	–		1,458	175	0		1,283	232	(H)	184	(H)	–	
1986	738	P(H)	2,709	102	0		2,607	556	(H)	358	(H)	142	(H)
1987	933	E(H)	2,616	125	0		2,491	624	(H)	395	(H)	85	(H)
1988	–		2,037	43	0		1,994	437	E(H)	169	E(H)	54	E(H)
1989	893	E(H)	2,456	234	0	20	2,202	–		158	E(H)	34	E(H)
1990	1,381	E(H)	1,915	202	0	15	1,698	–		325	E(H)	32	E(H)
1991	–		2,489	241	0	25	2,223	121	N(H)	86	E(H)	63	E(H)
1992	261	P(H)	1,367	88	0	36	1,243	86	P(H)	77	N(H)	16	N(H)
1993	1,058	N(H)	3,303	64	0	18	3,221	326	N(H)	351	E(H)	50	N(H)
1994	1,558	N(H)	3,727	99	0	8	3,620	349	N(H)	342	E(H)	67	N(H)
1995	1,053	E(H)	5,678	260	0	21	5,397	338	P(H)	260	P(H)	–	
1996	788	N(H)	3,599	215	0	2	3,382	132	N(H)	230	N(H)	12	N(H
1997	718	P(H)	2,989	160	0	0	2,829	109	P(H)	190	P(H)	–	
1998	–		1,364	17	0	0	1,347	71	P(H)	136	N(H)	39	N(H)
1999	500	P(H)	2,193	27	0	0	2,166	371	E(H)	194	N(H)	51	N(H)
2000	–		1,365	44	0	0	1,321	168	N(H)	152	N(H)	33	N(H)
2001	–		1,825	87	0	0	1,738	543	N(H)	287	N(H)	21	N(H)
1992–2001 average	848		2,741	106	0	9	2,626	249		222		36	
2002	-		2,241	100	0	0	2,121	351	N(H)	220	N(H)	86	E(H)

— = no survey; (A) = aerial survey from fixed wing aircraft; (H) = helicopter survey; E = excellent survey conditions; N = normal conditions; P = poor conditions.

[a] Escapement counts prior to 1975 may not be comparable because of differences in survey dates and counting methods.

[b] Klukshu River escapement = weir count minus above weir aboriginal and sport fishery, and broodstock.

the distribution of spawning chinook salmon in the Alsek River, and (3) to estimate the age, sex, and length compositions of chinook salmon spawning in the Alsek River.

Results from the study provide a survey expansion factor; i.e., an estimate of the fraction of escapement to the Alsek River counted at the Klukshu River weir. Results also provide information on run timing through the lower Alsek River of chinook salmon bound for the various spawning areas.

STUDY AREA

The Alsek River drainage covers about 28,000 km^2 (Bigelow et al. 1995). The drainage supports spawning populations of anadromous Pacific salmon, including chinook salmon; however, most anadromous production in the Alsek drainage is limited to the Tatshenshini River because of a velocity barrier on the lower Alsek near Lowell Glacier (Turnback Canyon, rkm 130) (Figure 1). Significant numbers of chinook salmon spawn in various tributary streams of the Tatshenshini River, including the Klukshu River, the Blanchard River, the Takhanne River, and Goat Creek (Figure 2). Other significant spawning areas exist downstream of the confluence of the Klukshu and Tatshenshini rivers in mainstream areas of the Tatshenshini and Alsek rivers. Small numbers of chinook salmon have been documented spawning in Village, Kane, Silver, Bridge, Detour, O'Connor, Low Fog and Stanley creeks, and in the Bridge River. The Klukshu and upper Tatshenshini rivers are accessible by road from the Haines Highway.

METHODS

The number of large chinook salmon in the Alsek River escapement was estimated from a two-event mark-recapture experiment for a closed population (Seber 1982:59–61). Fish captured by set gillnets in the lower river near Dry Bay and marked were included in event 1. Chinook salmon captured upstream on or near their spawning grounds constituted event 2 in the mark-recapture experiment.

DRY BAY TAGGING

Set gillnets 120 feet (36.5 m) long, 18 feet (5.5 m) deep, and made of 7.25-inch (18.5-cm) stretch mesh, were fished on the lower Alsek River, between May 17 and July 2; from May 21 through July 2, a similar net with 5¼" (13.5-cm) mesh was fished at a nearby site. Nets were fished daily unless prevented by high water. The primary fishing site for the larger-meshed gear was at approximately river kilometer (rkm) 19, just above the boundary of the Dry Bay commercial fishery. The tagging site is below all known spawning areas, and is upstream of any tidal influence. Other nearby sites were fished when water levels were too high to safely fish the primary site. The primary site for the smaller-meshed gear was upriver a few km near the outlet of Alsek Lake. Nets were watched continuously, and captured fish were removed from the net as soon as observed. Sampling effort was held reasonably constant across the temporal span of the migration. If fishing time was lost from entanglements, snags, net cleaning, etc., the lost time (processing time) was added on to the end of the day to bring fishing time for the larger-mesh gear to 8 hours/day and 7 hours/day for the smaller-mesh gear.

Captured chinook salmon were placed in a plastic fish tote filled with water, quickly untangled or cut from the net, tagged, scale sampled, and their length and sex recorded during a visual examination (as per Johnson et al. 1993). Fish were classified as 'large' if their mideye to fork length (MEF) was $\geq$660 mm, 'medium' if between 440 and 659 mm or 'small' if <440 mm (Pahlke and Bernard 1996). General health and appearance of the fish were noted, including injuries due to handling or predators. Each uninjured fish was marked with a uniquely numbered, blue spaghetti tag, consisting of a 2" (~5-cm) section of Floy tubing shrunk onto a 15" (~38-cm) piece of 80-lb (~36.3-kg) monofilament fishing line. The monofilament was sewn through the musculature of the fish approximately 20 mm posterior and ventral to the dorsal fin and secured by crimping both ends in a line crimp. Each fish was also marked with a ¼"-diameter (6-mm) hole in the upper (dorsal) portion of the left operculum applied with a paper punch, and by amputation of the left axillary appendage (as per McPherson et al. 1996). Fish that were seriously injured were sampled to determine their length, age and sex but were not tagged .

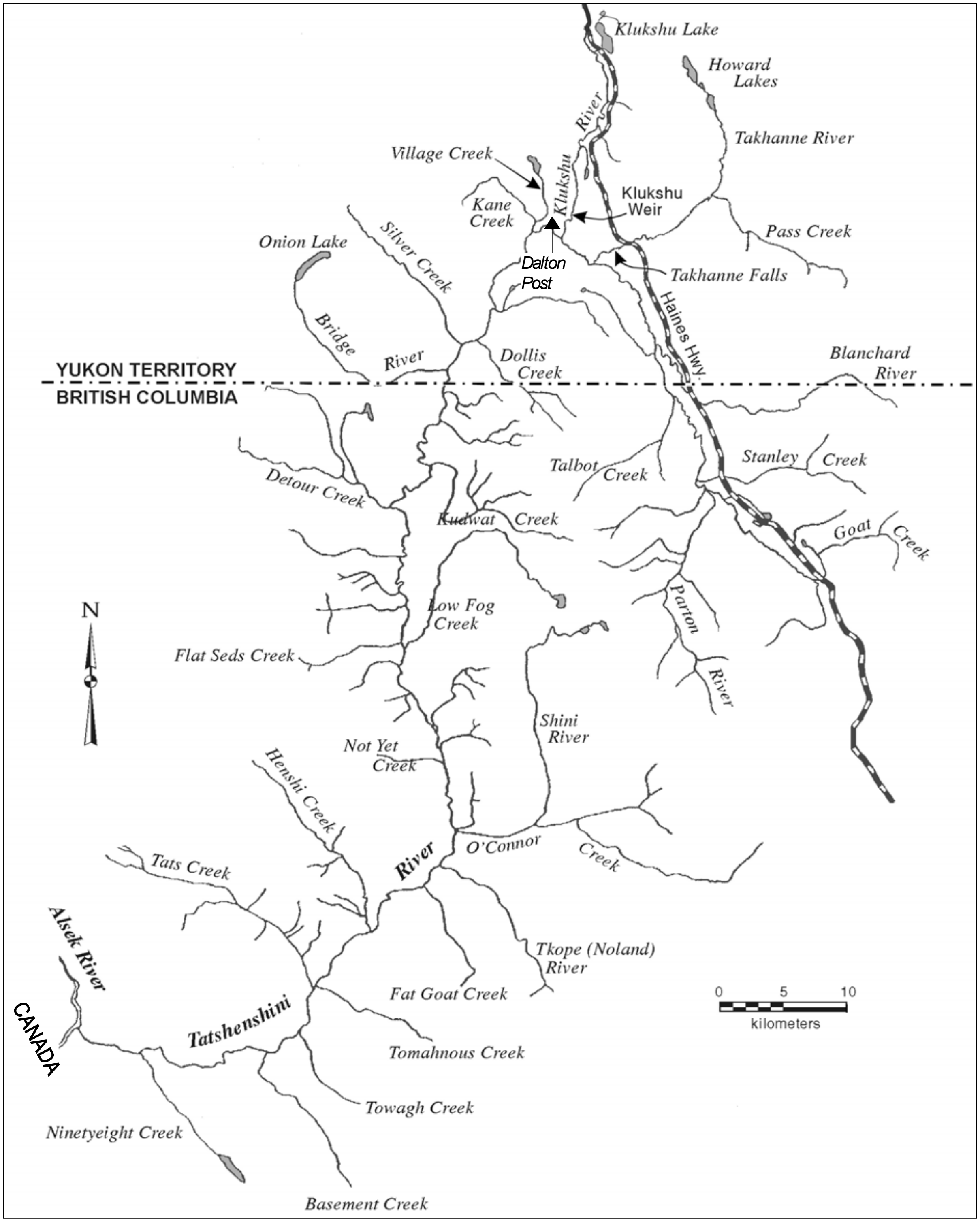

Figure 2.–Tatshenshini River drainage and associated tributaries, Yukon Territory and northern British Columbia, Canada.

SPAWNING GROUND SAMPLING

During event 2, pre- and post spawning fish were sampled at the Klukshu River weir. As fish entered a trap in the weir, a portion were captured; sampled to determine their length, sex, and age; inspected for marks; marked with a hole punched in the left operculum to prevent resampling; and released. In addition, some post-spawning fish and carcasses were sampled upstream of the weir and some pre-spawning fish were sampled below the weir. Foot surveys of the spawning areas on the Blanchard and Takhanne rivers and Goat Creek, were conducted July 30–August 7, 2002. Both pre- and post-spawning chinook salmon were sampled to determine their length, sex, age and the presence of marks.

FISHERY SAMPLING

Catches in Canadian fisheries in the upper Tatshenshini River and the U.S. gillnet fisheries below the tagging site were sampled to estimate age, sex, and length and were inspected for tags.

ABUNDANCE

The number of marked fish on the spawning grounds was estimated by subtracting the estimated number of marked fish removed by fishing in U.S. fisheries (censored from the experiment) from the number of fish tagged in event 1. Handling and tagging has caused a downstream movement and/or a delay in upstream migration of marked chinook salmon in other studies (Bernard et al. 1999, Pahlke and Etherton 1999, Bendock and Alexandersdottir 1992, Johnson et al. 1992, Milligan et al. 1984). This behavior puts fish marked in June and July at risk of capture in the downstream commercial fishery in U.S. waters that begins in early June; fish marked earlier would have no such risk. Censoring marked chinook salmon killed in this fishery avoided bias in estimates of abundance from this phenomenon. The tagging program was well publicized with a reward for each tag recovered, and almost the entire catch goes through one processor where a high proportion of the U. S. catch was inspected for marks.

Because of a reward (Can$5 for spaghetti tag) for each tag returned from the inriver Canadian recreational and aboriginal fisheries, tags from all marked fish caught in these fisheries were considered recovered.

The validity of the mark-recapture experiment rests on several assumptions, including: (a) every fish has an equal probability of being marked in event 1, *or* that every fish has an equal probability of being captured in event 2, *or* that marked fish mix completely with unmarked fish; (b) *both* recruitment and 'death' (emigration) do not occur between sampling events; (c) marking does not affect catchability (or mortality) of the fish; (d) fish do not lose their marks between sampling events; (e) all recovered marks are reported; and (f) double sampling does not occur (Seber 1982). Assumption (a) implies that marking must occur in proportion to abundance during immigration, or if it does not, that there is no difference in migratory timing among stocks bound for different spawning locations, since temporal mixing can not occur in the experiment. We attempted to meet assumption (a) by fishing the same gear in a standardized method throughout the chinook salmon migration. Assumption (a) also implies that sampling is not size or sex-selective. If capture on the spawning grounds was not size-selective, fish of different sizes would be captured with equal probability. The same is true for sex-selective sampling on the spawning grounds. If assumption (a) was met, fish sampled in upper Tatshenshini (Blanchard and Goat creeks) and Klukshu River spawning sites and in the recreational fishery would be marked at similar rates.

Contingency table analysis was used to test the assumption of proportional tagging. The hypothesis that fish of different sizes were captured with equal probability was also tested using two Kolmogorov-Smirnov (K-S) 2-sample tests (α = 0.05). These hypotheses tests and adjustments for bias are described in Appendix C. Assumption (b) was met because the life history of chinook salmon isolates those fish returning to the Alsek River as a 'closed' population. We assumed marked and unmarked fish experience the same mortality (assumption c) due to natural causes, and censoring was used to adjust the potentially higher harvest rate of marked fish in the U.S. commercial fishery. However, assumption (c) may have been violated with sampling at the Klukshu weir. Tagged fish have a higher probability of being sampled than untagged fish when trap loads of salmon are inspected only when a tagged fish is recognized as being in the load. If all marked fish passing through the weir had kept their tags, and if all passing tagged fish had been recognized, assumption (c) would still have been met.

To minimize effects of tag loss, all marked fish received secondary (a dorsal left opercle punch), and tertiary marks (the left axillary appendage was clipped). Similarly, we inspected all fish captured on the spawning grounds for marks (assumption e), and double sampling was prevented by an additional mark (ventral opercle punch) (assumption f). Variance, statistical bias, and confidence intervals for the abundance estimate were estimated with modifications of bootstrap procedures in Buckland and Garthwaite (1991).

We used the following equations to estimate the expansion factor for counts $C_{W,t}$ at the weir on the Klukshu River into estimates of abundance N_t of large chinook salmon spawning in the Alsek River, where t is year, k is the number of estimates of π, π is the ratio (expansion factor) where i denotes years with mark-recapture experiments:

$$\hat{\pi}_i = \hat{N}_i C_{W,i}^{-1} \quad (1)$$

$$v(\hat{\pi}_i) = v(\hat{N}_i) C_{W,i}^{-2} \quad (2)$$

$$\bar{\pi} = \frac{\sum_{i=1}^{k} \hat{\pi}_i}{k} \quad (3)$$

$$v(\pi) = \frac{\sum_{i=1}^{k} (\hat{\pi}_i - \bar{\pi})^2}{k-1} \quad (4)$$

DISTRIBUTION OF SPAWNERS

Radiotelemetry was used to estimate the distribution of chinook salmon in the Alsek River drainage. Two of every five large healthy chinook salmon had a 148 MHz LOTEK radio transmitter esophageally inserted into its stomach as per methods in Eiler (1990). Individual transmitters were identified by digitally encoded signals developed by LOTEK.

Radiotagged fish that moved upriver were recorded by fixed, remote tracking stations (towers) at selected sites in the drainage. The tracking stations were constructed and operated in a similar fashion as described in Eiler (1995), but without satellite up-link capabilities. Instead, records of radiotagged fish movements were downloaded periodically from the tracking station receivers to a laptop computer. Tracking stations were installed at eight locations on the Alsek River drainage. The lowest site (1) was about 4 km downriver from the primary tagging site to record all radiotagged fish that moved downriver.

Station 2 was located on the lower Tatshenshini river just upriver from the confluence of the Alsek River. Another tracking station (3) was installed near Kane Creek on the Tatshenshini River below Dalton Post; station (4) was on Village Creek, and station (5) was operated immediately downstream of the Klukshu River weir to record all radio-tagged fish that approached the weir. Station (6) was at the mouth of the Takhanne River, station (7) at the mouth of the Blanchard River, and the final station (8) near Stanley Creek on the upper Tatshenshini River.

Assumptions of the experiment to estimate spawning distributions include: a) test subjects were chosen in proportion to abundance during the immigration, b) tagging did not change the destination (fate) of a fish; and c) fates of test subjects are accurately determined. The first assumption will be true if fishing effort and catchability were constant for all 'stocks' (fish spawning in the same area) in the immigration (stocks might be characterized by their age composition and immigration timing). Catchability would presumably vary with river conditions. Thus, sampling effort was held as constant as practical during the immigration. The river stage (height) was recorded for comparison to catch rates at the gillnet sites.

In addition to the data recorded at each tower, an attempt was made to locate each radio transmitter periodically by helicopter. The location of each tag was recorded in a handheld GPS device and by rkm from the mouth of the river or tributary. After combining the data from the tracking stations and the tracking surveys, each radio-tagged fish was assigned one of four possible fates (Table 4; Johnson et al. 1993). Each fish assigned

Table 4–Criteria used to assign fates to radio-tagged chinook salmon.

FATE CODES AND CRITERIA	
1	Probable spawning in a tributary: a chinook salmon whose radio transmitter was tracked into a tributary, and remained in or was tracked downstream from that location. When a transmitter was tracked to more than one tributary, the last tributary was assumed to be the spawning location.
2	Mortality or regurgitation: a chinook salmon whose radio transmitter either did not advance upstream after tagging, or stopped in the mainstem Alsek River and never tracked to a lower location in the river.
3	Gillnet mortality: chinook salmon captured in the Alsek River commercial fishery.
4	Upriver Fishery: chinook salmon harvested in upriver sport or aboriginal fisheries.

to fate *1* (probable spawning in a tributary) was then further assigned to a final spawning area.

The proportion of large (660 mm and larger) chinook salmon spawning in each area was estimated

$$\hat{P}_a = \frac{\sum_{t=1}^{y}\left(\frac{N_t}{n_t}\right) r_{a,t}}{\sum_{a=1}^{x}\sum_{t=1}^{y}\left(\frac{N_t}{n_t}\right) r_{a,t}} \tag{5}$$

where

$r_{a,t}$ = the number of large fish tagged with radios in period t that were tracked to and assumed to spawn in area a (= 1 to 8)

N_t = the number of large fish captured in gillnets in period t, and

n_t = the number of large fish tagged in period t that were tracked to a spawning area .

Period (t) refers to distinct spans of time when the tagging fraction was constant. Transmitters assigned to fates not associated with successful spawning (Table 4) are ignored in computing $\hat{P}_a$, so that the sum of the estimated proportions equals one. The standard error of $\hat{P}_a$ was estimated using simulation with 1,300 trials. In each period, n_t new samples were drawn from all assigned fates (Table 4) using the empirical distribution of the data, and new values of $\hat{P}_a$ computed. Confidence intervals for the estimated proportions were calculated from the 1,300 trials using the percentile method (Efron and Tibshirani 1993), since the assumption of normality was clearly inappropriate for the smaller estimated proportions.

AGE, SEX, AND LENGTH COMPOSITION OF ESCAPEMENT

Scales were sampled from all fish captured at the Dry Bay tagging site and during spawning ground surveys and from portions of the Canadian aboriginal and recreational harvests to determine their age (Olsen 1995). Five scales were collected from the preferred area of each fish (Welander 1940), mounted on gum cards and impressions were made in cellulose acetate (Clutter and Whitesel 1956). Age of each fish was determined later from the pattern of circuli on images of scales magnified 70× (Olsen 1995). Samples from Dry Bay were processed at the ADF&G Scale Aging Lab in Douglas, AK; all other samples were processed at the DFO lab in Nanaimo, B.C. All scales were read by at least one staff member, with unusual or questionable scales read again by one or more staff.

The proportion of the spawning population composed of a given age within small-medium or large categories of salmon was estimated as a binomial variable from fish sampled on the spawning grounds:

$$\hat{p}_{ij} = \frac{n_{ij}}{n_i} \tag{6}$$

$$v[\hat{p}_{ij}] = \frac{\hat{p}_{ij}(1 - \hat{p}_{ij})}{n_i - 1} \tag{7}$$

where $\hat{p}_{ij}$ is the estimated proportion of the population of age j in size category i, n_{ij} is the number of chinook salmon of age j in size category i, and n_i is the number of chinook salmon in the sample n of size category i taken on the spawning grounds.

Numbers of spawning fish by age j were estimated as the summation of products of estimated age composition and estimated abundance, minus harvest, within a size category i:

$$\hat{N}_j = \sum_i (p_{ij}\hat{N}_i) \tag{8}$$

with a sample variance calculated according to procedures in Goodman (1960):

$$v(\hat{N}_j) = \sum_i \begin{pmatrix} v(\hat{p}_{ij})\hat{N}_i^2 + v(\hat{N}_i)\hat{p}_{ij} \\ -v(\hat{p}_{ij})v(\hat{N}_i) \end{pmatrix} \tag{9}$$

The proportion of the spawning population composed of a given age was estimated by:

$$\hat{p}_j = \frac{\hat{N}_j}{\hat{N}} \tag{10}$$

where $\hat{N} = \sum \hat{N}_i$. Variance of $\hat{p}_j$ was approximated according to the procedures in Seber (1982):

$$v(\hat{p}_j) = \frac{\sum_i \left(v(\hat{p}_{ij})\hat{N}_i^2 + v(\hat{N}_i)(\hat{p}_{ij} - \hat{p}_j)^2 \right)}{\hat{N}^2} \tag{11}$$

Sex and age-sex composition for the spawning population and associated variances were also estimated with the equations above by first redefining the binomial variables in samples to produce estimated proportions by sex $\hat{p}_k$, where k denotes sex, such that $\sum_k \hat{p}_k = 1$, and by age-sex, such that $\sum_{jk} \hat{p}_{jk} = 1$.

Age, sex, and age-sex composition and associated variances for the Dry Bay, and Alaska commercial fisheries samples were also estimated as described above.

Estimated age composition of chinook salmon captured in the different spawning areas was compared using a chi-square test, prior to combining these samples. Estimated age composition of the gillnet samples was compared with estimated age composition from data pooled across spawning grounds using another chi-square test. Estimates of mean length at age and their estimated variances were calculated with standard normal procedures.

RESULTS

DRY BAY

Between May 17 and July 31, 2002, 582 large (448 in larger-mesh gear, 134 in the other) and 98 small and medium (48 in larger-mesh gear, 50 in the other) chinook salmon were captured in the lower Alsek River. Of these, 552 large and 88 medium fish were sampled, marked and released (Table 5 Appendix A1). Set gillnet effort was maintained at 8 hours per day for chinook net and 7 hours per day for sockeye net, although reduced sampling effort occurred on several days (Figure 3; Appendix A1). Catch rates in the larger-mesh gear ranged from 0 to 4.1 fish/net-hour and peaked on June 10, when 33 large chinook salmon were captured (Figures 4, 5). The date of 50% cumulative catch was June 9. The sex ratio of chinook salmon caught in the gillnets was slightly skewed towards males (306 females, 379 males). In addition, each healthy sockeye salmon captured was marked with a spaghetti tag and a portion marked with radio tags and released as part of separate mark-recapture experiment conducted by Commercial Fisheries Division and DFO.

FISHERY SAMPLING

The inriver U.S. commercial gillnet fishery harvested 700 chinook salmon—including 20 tagged fish, and U.S. subsistence and personal use fisheries harvested 60 more (Tables 2, 5).

SPAWNING GROUND SAMPLING

Of the 2,241 chinook salmon observed passing through the Klukshu River weir, 501 were sampled, of which 462 were large fish and 44 were marked (Table 5). Of fish sampled at the

Table 5–Numbers of chinook salmon marked on lower Alsek River, removed by fisheries and inspected for marks in tributaries in 2002, by length group. Numbers in bold used in mark-recapture estimate.

		Length (MEF)			
		Small 0–439 mm	Medium 440–659 mm	Large ≥660 mm	Total
A. Released at Dry Bay with marks		7	88	552	647
B. Removed by:					
1. U.S. sport/subsistence		0	0	0	0
2. U.S. gillnet		0	2	18	20
Subtotal of removals		0	2	18	20
C. Estimated number of marked fish remaining in mark-recapture experiment		7	86	**534**	627
D. Spawning ground samples					
Observed at Klukshu weir	Observed		174	2,067[a]	2,241
	Marked		11	**126**	137
	Marked/observed		0.0632	0.0610	0.0611
Inspected at:					
1a. Klukshu weir live	Inspected	2	37	462	501
	Marked	0	4	45[b]	50
	Marked/inspected		0.1081	0.0974	0.0998
1b. Klukshu weir carcass	Inspected	0	5	23	28
	Marked	0	0	1	1
	Marked/inspected		0.0000	0.0435	0.0357
2. Blanchard/ Takhanne/Goat	Inspected	0	11	**204**	215
	Marked	0	1	**11**	12
	Marked/ inspected		0.0909	0.0539	0.0558
3. Sport fishery	Harvest		*Estimated catch, voluntary tag returns*		183
	Marked				7
	Marked/inspected				0.0383
4. Aboriginal fishery	Harvest		*Estimated catch, voluntary tag returns*		120
	Marked				10
	Marked/inspected				0.0833

[a] Size category estimated from sample proportions.

[b] Includes one tag loss.

weir, 269 were females and 230 males. One tag loss (2.0%) was noted in the sample of fish examined.

The 1,747 fish unsampled chinook salmon passing through the weir were not physically examined (inspected) for marks; however, each fish was carefully observed from a short distance as they passed over a white observation board, and all tagged fish are believed to have been observed (Appendix A3). Size and sex of each fish were not estimated. Twenty-three (23) carcasses were sampled at or above the weir, with 1 marked fish recovered.

At Blanchard River, 126 (119 large) live chinook and carcasses were examined for marks, with 6 marked fish recovered (Table 5). At Goat Creek

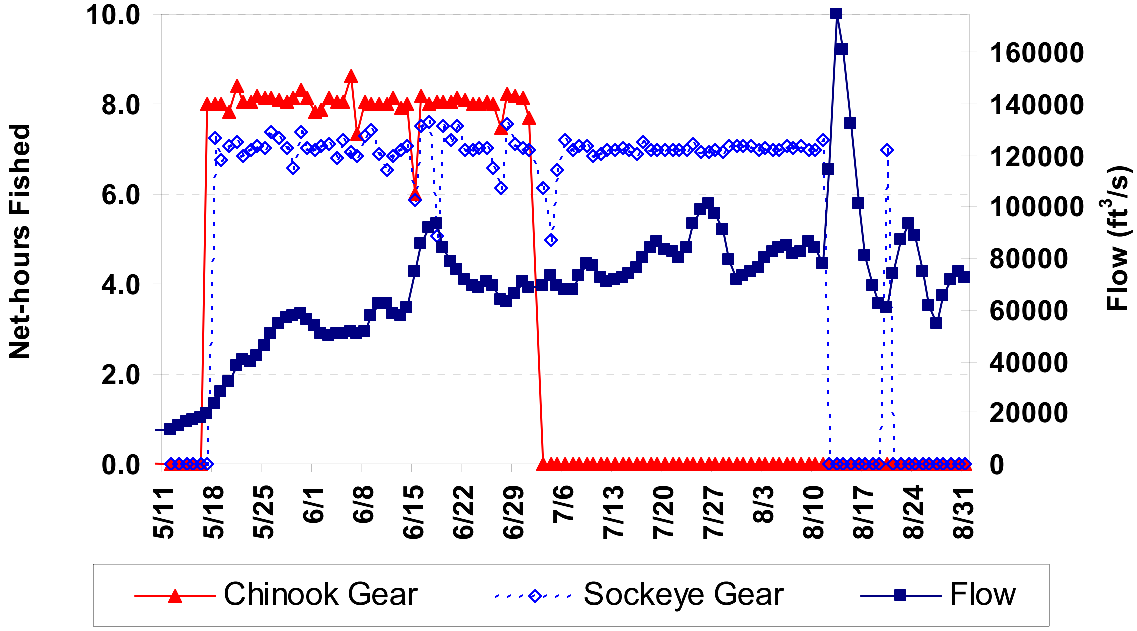

Figure 3.–Daily fishing effort (hours) **for chinook** (7¼") **and sockeye** (5¼") **gillnets and river flow** (ft^3/s)**, Alsek River near Dry Bay, 2002.** Flow information from USGS water information system.

on the upper Tatshenshini River, 9 large chinook salmon were sampled with 1 tag recovered, and on the Takhanne River 80 (76 large) fish were sampled with 5 tags recovered. The aboriginal fishery near Dalton Post harvested an estimated 120 chinook salmon with 10 tags returned. The entire catch was not sampled, but all tagged fish harvested are assumed to have been reported because of the close proximity of the DFO camp and signs posted describing the tagging study and reward program. The sport fishery near Dalton Post harvested about 183 chinook, with additional fish released. Thirty-nine (39) fish were examined by DFO technicians, and 7 tagged fish were recovered or reported.

ABUNDANCE

The mark-recapture estimate for large fish only passing Dry Bay is 8,807 fish (SE = 623). An estimated 534 marked fish moved upstream, 137 of which were found in the 2,271 fish inspected upstream on the spawning grounds or observed at the weir (Table 5). A bootstrap estimate of the 95% confidence interval around the estimated abundance is 7,765–10,143 fish; estimated statistical bias is 0.47%.

After subtracting the Canadian inriver harvest of 303, which is primarily large fish, the estimated number of large spawners in the entire Alsek River is 8,504 fish.

Samples taken at Blanchard and Takhanne Rivers and Goat Creek were pooled because their marked fractions are not significantly different (0.050 vs 0.067 vs 0.125, $\chi^2 = 0.751$, df = 2, P = 0.687). The marked fractions of the Blanchard and Takhanne river pooled sample were significantly different from those of fish *inspected* at the Klukshu River weir (0.056 vs 0.099, $\chi^2 = 3.68$, df = 1, P = 0.055). However, the estimated marked fraction for large fish *observed* at the weir is the same as that estimated for the pooled Blanchard and Takhanne samples (0.056 vs 0.061, $\chi^2 = 0.082$, df = 1, P = 0.774).

Most of the estimated harvest in the aboriginal fisheries was taken above the weir so those samples could not be included in the mark-recapture analysis and inspected sample size in the sport fishery was too small to be included in the analysis.

The combined length distributions of medium and large fish marked in Dry Bay were not

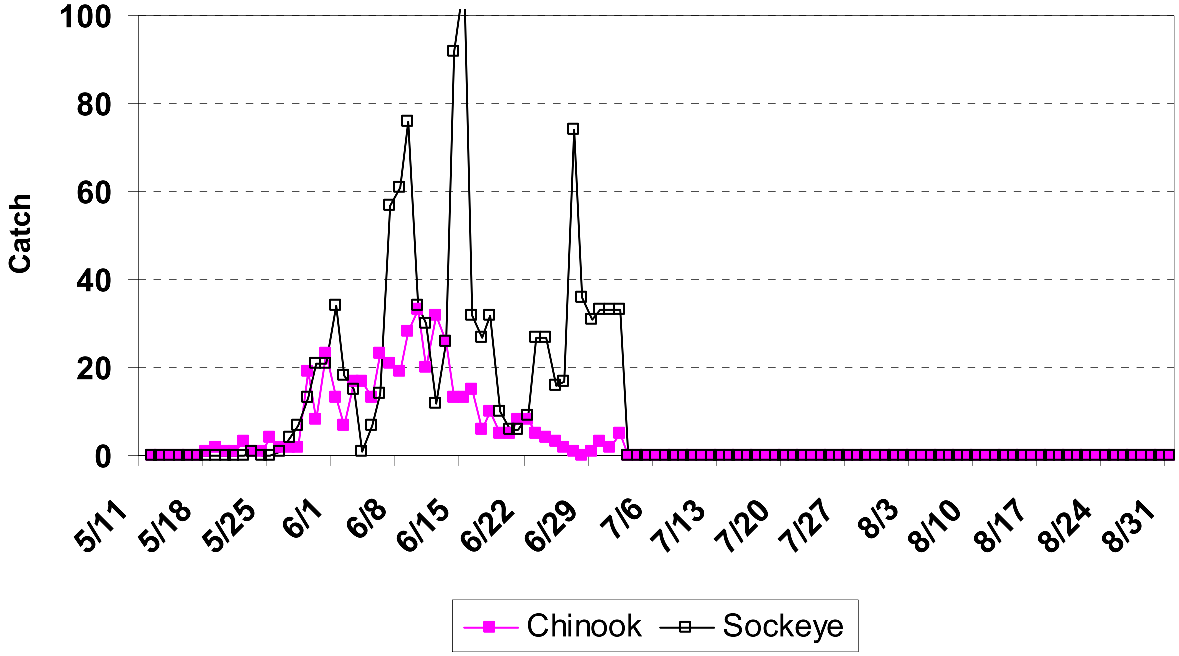

Figure 4.–Daily catch of chinook and sockeye salmon in the larger-mesh gillnet, lower Alsek River, 2002.

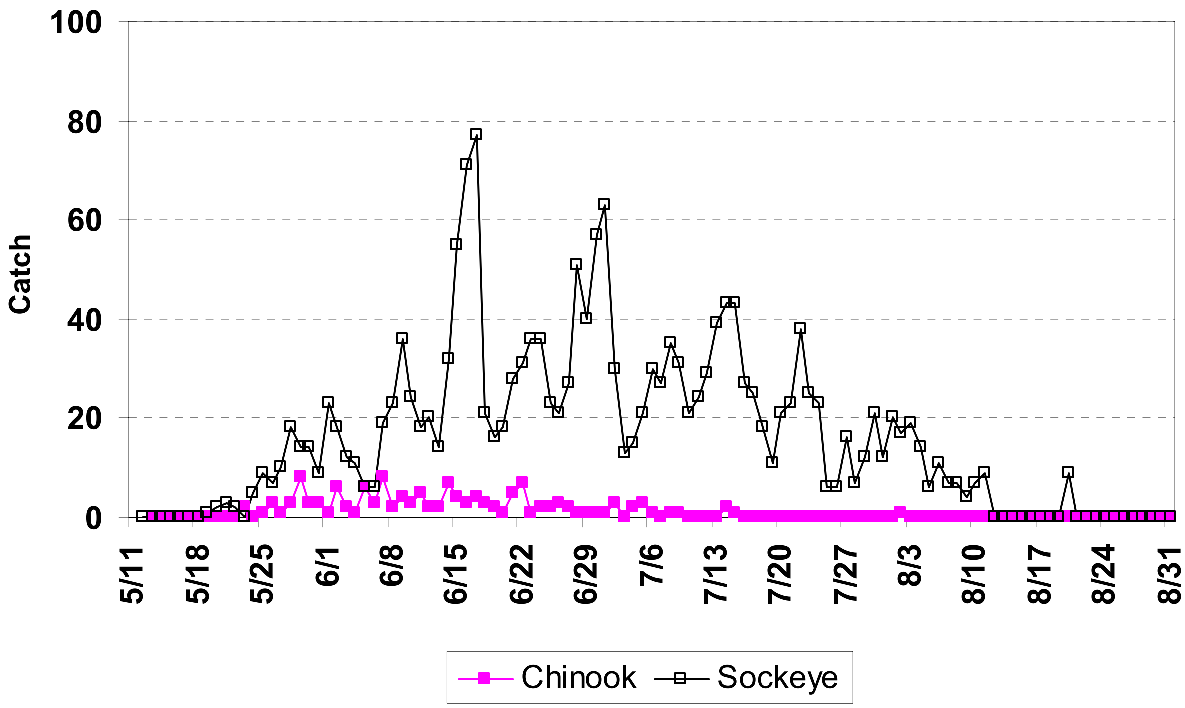

Figure 5.–Daily catch of chinook and sockeye salmon in the smaller-mesh gillnet, lower Alsek River, 2002.

significantly different from length distributions for fish *recaptured* on the spawning grounds (P = 0.34; Figure 6, bottom), indicating that sampling at the Klukshu weir and other spawning grounds was not size-selective. Length distributions of marked chinook salmon were significantly different from all fish *sampled* on the spawning grounds (P <0.001; Figure 6) suggesting size-selective sampling in event 1. Results are similar when the samples are stratified by length and only large fish included.

Additional evidence from spawning ground sampling also supports the supposition that the tagging operation was size selective within the category of larger fish. Pooled length samples of large fish from the spawning grounds were arbitrarily split into two groups at the median length of large fish (835 mm MEF) to permit comparison of marked fractions:

	660–835 mm	> 835 mm
Marked	34	22
Unmarked	293	311
Marked fraction	0.116	0.071

These marked fractions were significantly different (χ^2 = 3.056, df = 1, P = 0.081).

Evidence from spawning ground sampling supports the supposition that every large chinook salmon had a nearly equal chance of being captured upriver regardless of its size. Pooled length samples of large fish from the spawning grounds were again split into two size groups as were samples of larger fish marked in Dry Bay. After censoring large fish removed by the U.S. gillnet fishery, rates of recaptured fish were compared as surrogates for probabilities of capture upstream:

	660–835 mm	> 835 mm
Released	337	238
Recaptured	34	22
Fraction	0.101	0.092

These fractions recaptured were not significantly different (χ^2 = 0.093, df = 1, P = 0.760).

Thus, there is evidence of size-selectivity during the first sampling event in Dry Bay, and only length, sex and age data from the second sampling event on the spawning grounds are used to estimate proportions in compositions (Appendix C1). There were not enough tag recoveries to estimate abundance of medium fish. Abundance of small and medium chinook salmon was estimated as described in Appendix C2 and estimated abundance by age and sex of the entire escapement is calculated in Table 6. The resulting estimate of total escapement is 9,510 fish (SE = 717).

AGE, SEX, AND LENGTH COMPOSITION OF ESCAPEMENT

Age 1.3 chinook salmon were again the most common in all samples, constituting an estimated 65% of fish sampled in Dry Bay, 53% at the weir across the Klukshu River, and 60% at Blanchard River/Takhanne/Goat Creek, (Appendix A4–A7). Age 1.4 fish were the second most common and age 1.2 fish third. Sampled populations were an estimated 43–57% males.

Estimated age compositions were significantly different for fish sampled at Dry Bay and at the Klukshu River (χ^2 = 36.70, df = 2, P = 0.<001). Estimated age composition of fish in the Klukshu River sample did not differ from estimates for fish at the other spawning ground locations (χ^2 = 2.787, df = 2, P = 0.248) so those samples were pooled. Because there is evidence of size-selectivity during the first sampling event in Dry Bay, only the pooled spawning ground samples are used to estimate length, sex and age composition.

DISTRIBUTION OF SPAWNERS

Of the 195 fish with radio transmitters, 181 (93%) were successfully tracked to spawning areas or captured in fisheries. The remaining 14 transmitters were either regurgitated, lost because a fish died before spawning, never found, or tracked in a way that defied assignment of a fate (Appendix B1). Six (6) radiotagged fish moved downriver and were captured in the U.S. gillnet fishery. Spawning radiotagged fish were assigned to one of these eight areas: (1) *Lower Tatshenshini:* Alsek km 70–Tatshenshini km 55; (2) *Middle Tatshenshini:* includes all fish recorded between km 55 and 100; (3) *Upper Tatshenshini River:* fish tracked above km 105 or recorded at Kane Creek tower but not tracked to Klukshu, Takhanne, or Blanchard rivers or Goat Creek; (4) *Low Fog Creek:* fish

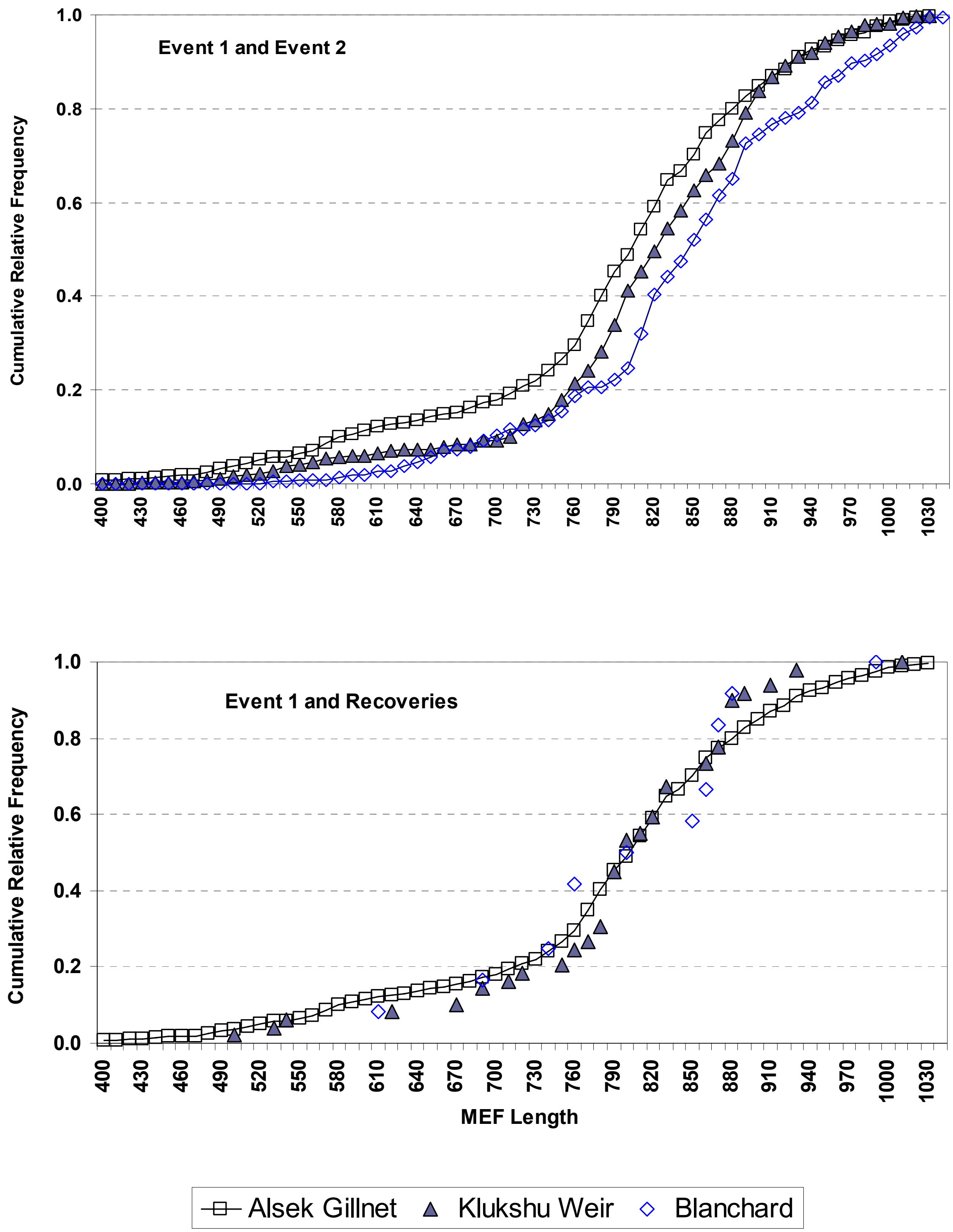

Figure 6.–Cumulative relative frequency of chinook salmon captured in event 1 (Dry Bay gillnet) **and marked chinook salmon recaptured in event 2** (spawning ground sampling, Klukshu weir)**, Alsek River, 2002.**

Table 6.–Estimated abundance and composition by age and sex of the escapement of chinook salmon in the Alsek River, 2002.

		Brood year and age class									
		1999	1998	1998	1997	1997	1996	1996	1995	1995	
		1.1	2.1	1.2	2.2	1.3	2.3	1.4	2.4	1.5	Total
SMALL AND MEDIUM CHINOOK											
Males	n	2	0	22	0	8	0	0	0	0	32
	%	4.5	0.0	50.0	0.0	18.2	0.0	0.0	0.0	0.0	72.7
	SE of %	3.2	0.0	7.6	0.0	5.9	0.0	0.0	0.0	0.0	6.8
	Escapement	32	0	352	0	128		0	0	0	511
	SE of esc.	25	0	182	0	73	0	0	0	0	260
Females	n	1	0	11	0	178	0	0	0	0	12
	%	2.3	0.0	25.0	0.0	31.1	0.0	0.0	0.0	0.0	27.3
	SE of %	2.3	0.0	6.6	0.0	2.1	0.0	0.0	0.0	0.0	6.8
	Escapement	16	0	176	0	2,957	0	0	0	0	192
	SE of esc.	16	0	97	0	276	0	0	0	0	105
Sexes combined	n	3	0	33	0	322	0	0	0	1	44
	%	6.8	0.0	75.0	0.0	56.2	0.0	0.0	0.0	0.2	100.0
	SE of %	3.8	0.0	6.6	0.0	2.3	0.0	0.0	0.0	0.2	0.0
	Escapement	48	0	527	0	5,341		0	0	17	703
	SE of esc.	34	0	267	0	423	0	0	0	17	352
LARGE CHINOOK											
Males	n	0	0	3	0	136	2	98	0	1	240
	%	0.0	0.0	0.6	0.0	25.8	0.4	18.6	0.0	0.2	45.5
	SE of %	0.0	0.0	0.3	0.0	1.9	0.3	1.7	0.0	0.2	2.2
	Escapement	0	0	50	0	2,268	33	1,635	0	17	4,003
	SE of esc.	0	0	29	0	232	24	189	0	17	342
Females	n	0	0	4	0	173	5	106	0	0	288
	%	0.0	0.0	0.8	0.0	32.8	0.9	20.1	0.0	0.0	54.5
	SE of %	0.0	0.0	0.4	0.0	2.0	0.4	1.7	0.0	0.0	2.2
	Escapement	0	0	67	0	2,886	83	1,768	0	0	4,804
	SE of esc.	0	0	34	0	272	38	198	0	0	390
Sexes combined	n	0	0	7	0	309	7	204	0	1	528
	%	0.0	0.0	1.3	0.0	58.5	1.3	38.6	0.0	0.2	100.0
	SE of %	0.0	0.0	0.5	0.0	2.1	0.5	2.1	0.0	0.2	0.0
	Escapement	0	0	117	0	5,154	117	3,403	0	17	8,807
	SE of esc.	0	0	45	0	411	45	305	0	17	623

tracked to Low Fog Creek or km 60–65; (5) *Klukshu River:* includes fish tracked to Klukshu River above and below the weir; (6) *Takhanne River*; (7) *Blanchard River*; and (8) *Goat Creek.* On the basis of radiotelemetry results, the proportions of large chinook spawning in each area of the Alsek/Tatshenshini River were estimated to be: Lower 13.1%, Middle 0.6%, Upper 8.6%, Low Fog 5.7% Klukshu 30.9%, Takhanne 13.7%, Blanchard 24.6%, and Goat 2.9%. Bootstrap confidence intervals for the proportions spawning in each area were asymmetric for the areas with small contributions (Table 7). These distributions were quite different from the proportions estimated in 1998, with lower contribution estimates to the lower tributaries and higher contributions to the Klukshu and other upper tributaries in 2002 (Figure 7).

The remote tracking stations did a good job in recording every radiotagged fish that passed them; however, there were malfunctions for short periods at the Kane Creek and Klukshu towers. The aerial surveys were useful in supplementing the data from the towers.

Telemetry data also provide an estimate of abundance. Of the 501 fish handled at the

Table 7.–Summary of fates assigned to radio transmitters on Alsek River, 2002 and 1998. Tags assigned to fates with estimated proportions spawning in each tributary, with SEs and upper and lower 95% confidence intervals for estimates.

		2002				1998			
		Estimated	Bootstrap			Estimated	Bootstrap		
Tributary	**Tags**	**proportion**	**SE**	**LCI**	**UCI**	**proportion**	**SE**	**LCI**	**UCI**
Lower Tats	23	13.1	2.6	8.4	18.5	23.0	3.6	16.0	30.5
Middle Tats	1	0.6	0.6	0.0	2.3	12.7	2.6	8.1	18.2
Low Fog	10	5.7	2.1	2.3	9.3	9.6	2.3	5.3	14.2
Upper Tats	15	8.6	2.4	4.8	12.9	18.6	3.1	12.7	24.7
Klukshu	54	30.9	3.5	24.5	37.8	15.8	2.9	10.4	21.7
Takhanne	24	13.7	2.6	8.9	19.2	8.8	2.4	4.1	13.8
Blanchard	43	24.6	3.2	18.6	31.0	9.0	2.2	4.8	13.5
Goat	5	2.9	1.3	0.6	5.7	2.6	1.3	0.5	5.6
	175	100.0				100.0			
Unknown	8	4.1				2.7			
Mortality	6	3.1				5.6			
Dry Bay gillnet	6	3.1				1.7			
	20	10.3				10.0			
Total tags Deployed	195					180			

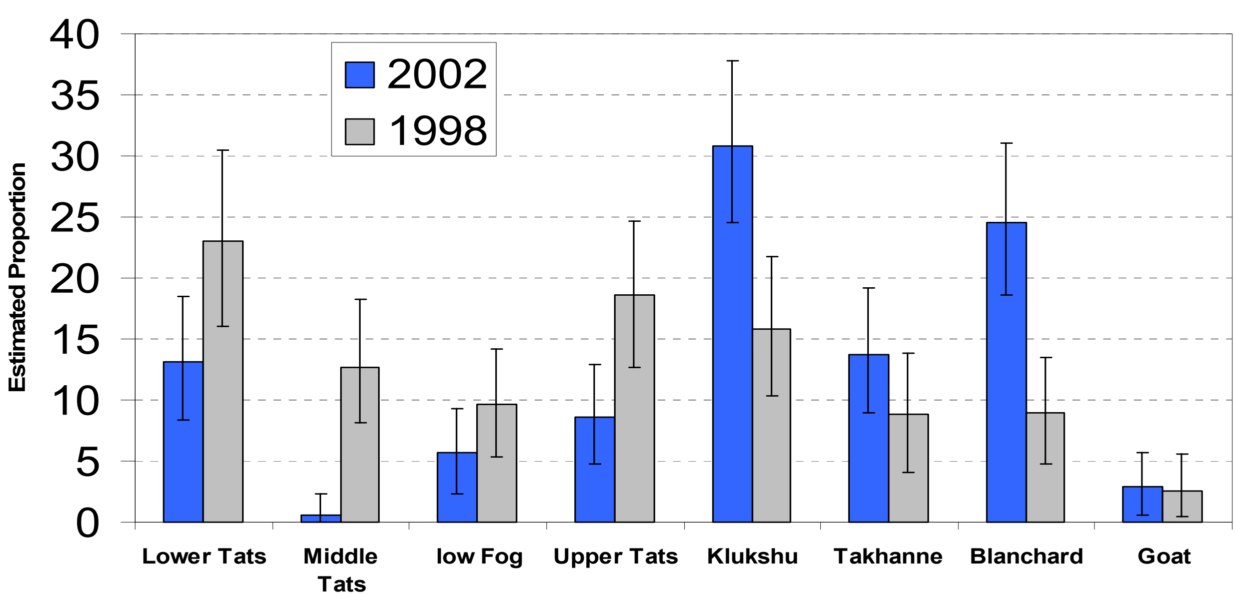

Figure 7.–Estimated spawning distribution of chinook salmon on Alsek River, 1998 and 2002, with 95% CI.

Klukshu River weir, 92% (462) were large fish, giving an estimate of 2,067 large fish passed through the weir. If 30.9% of radio tags passed through the weir (all on large fish), an estimate of abundance passing by Dry Bay would be 6,689 (2,067/0.309).

DISCUSSION

Using smaller mesh gillnets in 2002 to eliminate size-selective sampling at Dry Bay was partially effective. In 1998 and 1999 the large mesh (7¼") gillnets used in the tagging operation were selective towards larger fish, and that required that the mark-recapture analysis be stratified by size. In 2000 and 2001, smaller mesh sockeye salmon gear was fished in addition to the larger chinook gear and spawning ground samples were collected with a variety of gear from pre-spawning and post-spawning fish and carcasses. These changes decreased the size selectivity observed in previous years and eliminated the need to stratify the population estimate by size. However, in 2002 the catches from the combined gillnets tended to be smaller than the fish examined on the spawning grounds, indicating a potential size selectivity during the tagging operation. The smaller gear caught a similar number of jacks (41 compared to 48 in the larger-mesh gear) and fewer large fish (125 vs 448). However, the length composition of large chinook salmon caught in the smaller-mesh gear did not differ from that of those caught in the larger-mesh nets ($\chi^2 = 0.018$, df = 1, p = 0.894):

	660–835 mm	> 835 mm
Smaller mesh	80	53
Larger mesh	263	179

Although most fish observed in the second event of the mark-recapture experiment were not physically handled, there was no evidence that significant numbers of marked fish were not recognized as such. The blue tag used in the study was designed to prevent predators from targeting on marked fish. Our experience with these tags is that they were easy to see when small numbers of fish passed through the weir.

Differences in migratory timing of stocks within the Alsek River did not follow trends observed for other stocks in other rivers. Radiotelemetry studies conducted in 1998 and 2002 estimated the distribution and migratory timing of spawning chinook salmon in the Alsek and Tatshenshini rivers. About 46% of the spawning fish were tracked to areas in the lower and middle Tatshenshini River, downstream from the mouth of the Klukshu River in 1998 and about 20% in 2002. These fish spawn primarily in glacial waters where they are difficult to see or sample. Studies on the Taku, Stikine, Unuk and Chickamin rivers have shown, in general, chinook salmon migrating to lower tributaries migrated upriver later in the year than fish heading to spawning areas much farther upriver (Pahlke and Bernard 1996; Pahlke and Etherton 1999; Pahlke et al. 1996; Pahlke 1997). That trend was not apparent in the Alsek River study, with fish spawning in the lower and middle Tatshenshini River, and those heading to the upper Tatshenshini River, including the Klukshu, Blanchard, Takhanne rivers and Goat Creek; all passing through Dry Bay in a similar pattern. With no significant differences in run timing, it would be unlikely that fish going to different tributaries would be marked at different rates.

Traditional indicators of chinook salmon escapement to the Alsek River indicate an average escapement in 2002. The count at the Klukshu weir was above the count in 2001 and within the escapement goal range, but below the recent 10-year average of 2,741. Index counts in the Blanchard River and Goat Creek were above average. The number of large chinook salmon tagged at the set nets in Dry Bay increased from 245 in 1998, 402 in 1999, 479 in 2000, 529 in 2001, to 552 in 2002 due to the experience gained in operation of the nets the previous three years and the addition of the sockeye gear. The numbers of fish sampled at the Klukshu River weir and at the other recovery sites were slightly below 2001 numbers.

In 2002, 92.2% of the fish inspected at the weir were large fish, resulting in an estimated escapement through the weir of 2,067 large chinook salmon. This was about 24% of the mark-recapture estimated escapement of large fish, or an expansion factor ($\hat{\pi}_i$) of 4.11 (SE = 0.30). This was the highest estimated contribution rate for the Klukshu River in five years of population estimates and the high rate was supported by the radiotelemetry data which estimated over 30% Klukshu River stock. Expansion factors $\hat{\pi}_i$ for 1998, 1999, 2000, and 2001 were estimated at 6.33 (SE = 1.38), 6.97 (SE = 1.74), 6.81 (SE = 1.31), and 7.17 (SE = 0.87) respectively. The average over these four estimates is $\bar{\pi} = 6.82$ and its estimated variance $v(\pi) = 0.13$ (SE = 0.36). With the 2002 data included the estimate of $\bar{\pi}$ drops to 6.28 (SE = 1.56).

CONCLUSION AND RECOMMENDATIONS

This was the fifth attempt at estimating the total escapement of chinook salmon to the Alsek River. Set gillnets are an effective method of capturing large chinook salmon migrating up the Alsek River, although the tagging crew must respond to fluctuating river conditions which rapidly change the effectiveness of the gear. It appears that with the existing effort a sample size of 500 large fish tagged is possible. Sample sizes in event 2 must be increased to achieve an acceptably precise estimate of abundance, and the samples at the Klukshu River should be collected in a more systematic manner from all fish passing through the weir.

The results of the study indicate that the Klukshu River weir is a valid index of chinook salmon escapement to the Alsek River, but may be more variable than indicated in previous studies.

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APPENDIX A: GILLNET AND WEIR CATCHES AND AGE, SEX AND LENGTH SUMMARIES

Appendix A1.–Gillnet (chinook gear, 7¼") **daily effort** (hours fished)**, catches, cumulative catches, and catch per net hour, near Dry Bay, lower Alsek River, 2002.**

Date	Hours	Large chinook	Large tagged	Cumul. large tagged	Chinook radios	Cumul. radio	Jacks caught	Jacks tagged	Cumul. jacks tagged	Sockeye caught	Large chinook cumul.	Cumul. percent	CPUE
5/12	0.0	0	0							0	0	0.0%	
5/13	0.0	0	0	0	0	0	0	0	0	0	0	0.0%	
5/14	0.0	0	0	0	0	0	0	0	0	0	0	0.0%	
5/15	0.0	0	0	0	0	0	0	0	0	0	0	0.0%	
5/16	0.0	0	0	0	0	0	0	0	0	0	0	0.0%	
5/17	8.0	0	0	0	0	0	0	0	0	0	0	0.0%	0
5/18	8.0	1	1	1	0	0	0	0	0	0	1	0.2%	0.13
5/19	8.0	2	2	3	1	1	0	0	0	0	3	0.7%	0.25
5/20	7.8	1	1	4	0	1	0	0	0	0	4	0.9%	0.13
5/21	8.4	1	1	5	0	1	0	0	0	0	5	1.1%	0.12
5/22	8.0	3	3	8	2	3	0	0	0	0	8	1.8%	0.37
5/23	8.0	1	1	9	0	3	0	0	0	1	9	2.0%	0.12
5/24	8.2	1	0	9	0	3	0	0	0	0	10	2.2%	0.12
5/25	8.1	4	4	13	2	5	0	0	0	0	14	3.1%	0.49
5/26	8.1	2	2	15	1	6	0	0	0	1	16	3.6%	0.25
5/27	8.1	2	2	17	1	7	0	0	0	4	18	4.0%	0.25
5/28	8.0	2	2	19	1	8	0	0	0	7	20	4.5%	0.25
5/29	8.2	19	18	37	5	13	0	0	0	13	39	8.7%	2.33
5/30	8.3	8	7	44	4	17	1	1	1	21	47	10.5%	0.96
5/31	8.1	23	23	67	11	28	1	1	2	21	70	15.6%	2.83
6/1	7.8	13	13	80	6	34	2	2	4	34	83	18.5%	1.66
6/2	7.9	7	6	86	3	37	1	1	5	18	90	20.1%	0.89
6/3	8.1	17	14	100	6	43	4	4	9	15	107	23.9%	2.09
6/4	8.0	17	16	116	7	50	2	2	11	1	124	27.7%	2.12
6/5	8.0	13	13	129	4	54	0	0	11	7	137	30.6%	1.62
6/6	8.6	23	23	152	11	65	3	3	14	14	160	35.7%	2.67
6/7	7.3	21	21	173	8	73	2	2	16	57	181	40.4%	2.87
6/8	8.1	19	17	190	6	79	5	5	21	61	200	44.6%	2.36
6/9	8.0	28	26	216	14	93	5	5	26	76	228	50.9%	3.49
6/10	8.0	33	29	245	12	105	4	4	30	34	261	58.3%	4.13
6/11	8.0	20	16	261	7	112		0	30	30	281	62.7%	2.50

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Appendix A1.–Page 2 of 2.

Date	Hours	Large chinook	Large tagged	Cumul. large tagged	Chinook radios	Cumul. radio	Jacks caught	Jacks tagged	Cumul. jacks tagged	Sockeye caught	Large chinook cumul.	Cumul. percent	CPUE
6/12	8.2	32	30	291	11	123	1	1	31	12	313	69.9%	3.93
6/13	7.9	26	25	316	17	140	2	2	33	26	339	75.7%	3.28
6/14	8.0	13	13	329	7	147	1	1	34	92	352	78.6%	1.63
6/15	6.0	13	13	342	8	155	1	1	35	108	365	81.5%	2.17
6/16	8.2	15	15	357	7	162	2	2	37	32	380	84.8%	1.84
6/17	8.0	6	6	363	3	165	2	2	39	27	386	86.2%	0.75
6/18	8.1	10	10	373	5	170	4	4	43	32	396	88.4%	1.24
6/19	8.0	5	5	378	2	172	1	1	44	10	401	89.5%	0.62
6/20	8.0	5	5	383	2	174	0	0	44	6	406	90.6%	0.62
6/21	8.2	8	8	391	4	178	1	1	45	6	414	92.4%	0.98
6/22	8.1	8	8	399	3	181	0	0	45	9	422	94.2%	0.99
6/23	8.0	5	5	404	2	183	1	1	46	27	427	95.3%	0.63
6/24	8.0	4	4	408	2	185	0	0	46	27	431	96.2%	0.50
6/25	8.0	3	3	411	2	187	0	0	46	16	434	96.9%	0.37
6/26	8.0	2	2	413	1	188	0	0	46	17	436	97.3%	0.25
6/27	7.5	1	1	414	0	188	1	1	47	74	437	97.5%	0.13
6/28	8.2	0	0	414	0	188	0	0	47	36	437	97.5%	0.00
6/29	8.2	1	1	415	1	189	0	0	47	31	438	97.8%	0.12
6/30	8.1	3	3	418	1	190	1	1	48	33	441	98.4%	0.37
7/1	7.7	2	2	420	1	191	0	0	48	33	443	98.9%	0.26
7/2	8.2	5	4	424	4	195	0	0	48	33	448	1	0.61

Appendix A2.–Gillnet (sockeye gear, 5¼") **daily effort (hours fished), catches, cumulative catches, and river flow** (ft³/s) **near Dry Bay, lower Alsek River, 2002.**

Date	Hours	Large chinook	Large tagged	Cumul. large tagged	Cumul. percent	CPUE	Jacks caught	Jacks tagged	Cumul. jacks tagged	Sockeye caught	Flow
5/11	0	0			0.0					0	
5/12	0	0	0	0	0.0	0	0	0	0	0	13500
5/13	0	0	0	0	0.0	0	0	0	0	0	14800
5/14	0	0	0	0	0.0	0	0	0	0	0	16000
5/15	0	0	0	0	0.0	0	0	0	0	0	17000
5/16	0	0	0	0	0.0	0	0	0	0	0	18000
5/17	0	0	0	0	0.0	0	0	0	0	0	19500
5/18	7.3	0	0	0	0.0	0	0	0	0	0	23400
5/19	6.8	0	0	0	0.0	0	0	0	0	1	27800
5/20	7.1	0	0	0	0.0	0	0	0	0	2	32200
5/21	7.2	2	2	2	1.5	0.28	0	0	0	3	37800
5/22	6.8	0	0	2	1.5	0.00	0	0	0	2	40400
5/23	7.0	1	1	3	2.2	0.14	0	0	0	0	39900
5/24	7.1	3	3	6	4.5	0.42	0	0	0	5	42200
5/25	7.0	1	1	7	5.2	0.14	0	0	0	9	45800
5/26	7.4	3	2	9	7.5	0.41	1	1	1	7	50900
5/27	7.3	8	8	17	13.4	1.10	0	0	1	10	54700
5/28	7.0	3	3	20	15.7	0.43	1	1	2	18	56800
5/29	6.6	3	3	23	17.9	0.46	0	0	2	14	57600
5/30	7.4	1	1	24	18.7	0.14	0	0	2	14	58600
5/31	7.0	6	6	30	23.1	0.85	0	0	2	9	56100
6/1	7.0	2	2	32	24.6	0.29	0	0	2	23	53700
6/2	7.1	1	1	33	25.4	0.14	1	1	3	18	50800
6/3	7.1	6	6	39	29.9	0.84	0	0	3	12	49500
6/4	6.8	3	3	42	32.1	0.44	0	0	3	11	50700
6/5	7.2	8	8	50	38.1	1.11	0	0	3	6	50500
6/6	6.9	2	2	52	39.6	0.29	0	0	3	6	51200
6/7	6.9	4	4	56	42.5	0.58	1	1	4	19	50300
6/8	7.3	3	3	59	44.8	0.41	0	0	4	23	51600
6/9	7.4	5	5	64	48.5	0.67	2	2	6	36	57700
6/10	6.9	2	2	66	50.0	0.29	2	2	8	24	62100
6/11	6.6	2	2	68	51.5	0.31	2	2	10	18	62100
6/12	6.9	7	7	75	56.7	1.02	0	0	10	20	58000
6/13	7.0	4	3	78	59.7	0.57	2	2	12	14	57300
6/14	7.1	3	2	80	61.9	0.42	0	0	12	32	60600
6/15	5.9	4	4	84	64.9	0.68	5	5	17	55	74300
6/16	7.5	3	2	86	67.2	0.40	12	12	29	71	85800
6/17	7.6	2	2	88	68.7	0.26	9	3	32	77	92000
6/18	5.1	1	1	89	69.4	0.20	1	1	33	21	93500
6/19	7.5	5	5	94	73.1	0.67	1	0	33	16	84100
6/20	7.2	7	7	101	78.4	0.97	1	1	34	18	78900
6/21	7.5	1	1	102	79.1	0.13	0	0	34	28	75500
6/22	7.0	2	2	104	80.6	0.29	2	1	35	31	71400
6/23	7.0	2	2	106	82.1	0.29	1	1	36	36	68900
6/24	7.0	3	3	109	84.3	0.43	3	2	38	36	68700
6/25	7.0	2	2	111	85.8	0.29	0	0	38	23	70600
6/26	6.6	1	1	112	86.6	0.15	0	0	38	21	69100

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Date	Hours	Large chinook	Large tagged	Cumul. large tagged	Cumul. percent	CPUE	Jacks caught	Jacks tagged	Cumul. jacks tagged	Sockeye caught	Flow
6/27	6.1	1	1	113	87.3	0.16	1	1	39	27	63500
6/28	7.6	1	0	113	88.1	0.13	0	0	39	51	62900
6/29	7.1	1	1	114	88.8	0.14	0	0	39	40	66300
6/30	7.0	3	2	116	91.0	0.43	0	0	39	57	70400
7/1	7.0	0	0	116	91.0	0.00	0	0	39	63	68800
7/2	7.1	2	0	116	92.5	0.28	0	0	39	30	68200
7/3	6.1	3	3	119	94.8	0.49	0	0	39	13	69100
7/4	5.0	1	0	119	95.5	0.20	1	1	40	15	73300
7/5	6.6	0	0	119	95.5	0.00	0	0	40	21	69300
7/6	7.2	1	1	120	96.3	0.14	0	0	40	30	67400
7/7	7.0	1	1	121	97.0	0.14	0	0	40	27	67700
7/8	7.1	0	0	121	97.0	0.00	0	0	40	35	72900
7/9	7.1	0	0	121	97.0	0.00	0	0	40	31	77800
7/10	6.9	0	0	121	97.0	0.00	0	0	40	21	76900
7/11	6.9	0	0	121	97.0	0.00	0	0	40	24	72500
7/12	7.0	2	2	123	98.5	0.29	0	0	40	29	70500
7/13	7.0	1	1	124	99.3	0.14	0	0	40	39	71300
7/14	7.0	0	0	124	99.3	0.00	0	0	40	43	72600
7/15	7.0	0	0	124	99.3	0.00	0	0	40	43	73600
7/16	6.9	0	0	124	99.3	0.00	1	1	41	27	75900
7/17	7.2	0	0	124	99.3	0.00	0	0	41	25	79800
7/18	7.0	0	0	124	99.3	0.00	0	0	41	18	83800
7/19	7.0	0	0	124	99.3	0.00	0	0	41	11	86200
7/20	7.0	0	0	124	99.3	0.00	0	0	41	21	83500
7/21	7.0	0	0	124	99.3	0.00	0	0	41	23	82400
7/22	7.0	0	0	124	99.3	0.00	0	0	41	38	80200
7/23	7.0	0	0	124	99.3	0.00	0	0	41	25	83700
7/24	7.1	0	0	124	99.3	0.00	0	0	41	23	93000
7/25	7.0	0	0	124	99.3	0.00	0	0	41	6	98500
7/26	6.9	0	0	124	99.3	0.00	0	0	41	6	101000
7/27	7.0	0	0	124	99.3	0.00	0	0	41	16	97500
7/28	6.9	0	0	124	99.3	0.00	0	0	41	7	91000
7/29	7.1	0	0	124	99.3	0.00	0	0	41	12	79700
7/30	7.1	0	0	124	99.3	0.00	0	0	41	21	71300
7/31	7.1	1	1	125	100.0	0.14	0	0	41	12	73300
8/1	7.1	0	0	125	100.0	0.00	0	0	41	20	74400
8/2	7.0	0	0	125	100.0	0.00	0	0	41	17	76200
8/3	7.0	0	0	125	100.0	0.00	0	0	41	19	79900
8/4	7.0	0	0	125	100.0	0.00	0	0	41	14	82100
8/5	7.0	0	0	125	100.0	0.00	0	0	41	6	83700
8/6	7.1	0	0	125	100.0	0.00	0	0	41	11	85100
8/7	7.0	0	0	125	100.0	0.00	0	0	41	7	81700
8/8	7.1	0	0	125	100.0	0.00	0	0	41	7	82700
8/9	7.0	0	0	125	100.0	0.00	0	0	41	4	86500
8/10	7.0	0	0	125	100.0	0.00	0	0	41	7	84000
8/11	7.2	0	0	125	100.0	0.00	0	0	41	9	78000
8/12	0.0	0	0	125	100.0		0	0	41	0	114000
8/13	0.0	0	0	125	100.0		0	0	41	0	175000
8/14	0.0	0	0	125	100.0		0	0	41	0	161000
8/15	0.0	0	0	125	100.0		0	0	41	0	132000

Appendix A3.–Daily and cumulative counts of Klukshu River sockeye and chinook salmon through the Klukshu River weir, and chinook salmon sampled and tags observed, 2002.

Date	Sockeye daily	Chinook daily	Daily Prop.	Daily Cumul.	Cumul. prop.	Sampled daily	Sampled cumul.	Tags observed	Tags sampled
14-Jun	3	0	0.000	0	0.000	0	0		
15-Jun	2	4	0.000	4	0.002	2	2		
16-Jun	1	2	0.000	6	0.003	2	4		
17-Jun	4	0	0.000	6	0.003	0	4		
18-Jun	0	3	0.000	9	0.004	3	7		1
19-Jun	0	3	0.000	12	0.005	3	10		
20-Jun	0	3	0.000	15	0.007	2	12		
21-Jun	1	4	0.000	19	0.008	4	16		1
22-Jun	24	3	0.000	22	0.010	3	19		
23-Jun	7	1	0.000	23	0.010	1	20		
24-Jun	2	0	0.000	23	0.010		20		
25-Jun	12	4	0.000	27	0.012	4	24		
26-Jun	2	2	0.000	29	0.013	2	26		
27-Jun	3	5	0.000	34	0.015	5	31		
28-Jun	50	2	0.000	36	0.016	2	33		
29-Jun	345	29	0.001	65	0.029	6	39	2	
30-Jun	271	35	0.001	100	0.045	6	45		1
1-Jul	166	14	0.001	114	0.051	5	50		2
2-Jul	359	38	0.002	152	0.068	14	64		1
3-Jul	522	10	0.000	162	0.072	2	66	1	
4-Jul	404	56	0.002	218	0.097	13	79		
5-Jul	528	11	0.000	229	0.102	4	83		
6-Jul	648	26	0.001	255	0.114	13	96		
7-Jul	334	24	0.001	279	0.125	2	98		
8-Jul	640	120	0.005	399	0.178	13	111		1
9-Jul	380	38	0.002	437	0.195	13	124		
10-Jul	334	52	0.002	489	0.218	13	137		1
11-Jul	585	58	0.002	547	0.244	4	141	3	
12-Jul	170	26	0.001	573	0.256	15	156		
13-Jul	192	110	0.004	683	0.305	19	175	3	4
14-Jul	97	40	0.002	723	0.323	7	182	2	1
15-Jul	81	151	0.006	874	0.390	19	201	2	2
16-Jul	480	245	0.010	1119	0.500	15	216	15	1
17-Jul	281	120	0.005	1239	0.553	10	226	3	2
18-Jul	211	120	0.005	1359	0.607	15	241	4	
19-Jul	145	54	0.002	1413	0.631	7	248		1
20-Jul	18	19	0.001	1432	0.639	13	261	1	1
21-Jul	17	129	0.005	1561	0.697	18	279	12	4
22-Jul	49	128	0.005	1689	0.754	9	288	9	2
23-Jul	4	83	0.003	1772	0.791	8	296	3	1
24-Jul	62	92	0.004	1864	0.832	19	315	5	3
25-Jul	126	62	0.002	1926	0.860	44	359		5
26-Jul	163	71	0.003	1997	0.892	19	378	5	1
27-Jul	179	9	0.000	2006	0.896	19	397	6	1
28-Jul	8	1	0.000	2007	0.896	8	405		

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Date	Sockeye daily	Chinook daily	Daily Prop.	Daily Cumul.	Cumul. prop.	Sampled daily	Sampled cumul.	Tags observed	Tags sampled
29-Jul	11	19	0.001	2026	0.904	16	421		
30-Jul	92	30	0.001	2056	0.918	15	436	1	3
31-Jul	216	31	0.001	2087	0.932	20	456	3	1
1-Aug	165	13	0.001	2100	0.938	7	463		2
2-Aug	15	15	0.001	2115	0.944	11	474		1
3-Aug	205	14	0.001	2129	0.950	1	475	2	
4-Aug	222	12	0.000	2141	0.956	5	480		2
5-Aug	61	4	0.000	2145	0.958	2	482	1	
6-Aug	71	12	0.000	2157	0.963	2	484	2	
7-Aug	21	3	0.000	2160	0.964	1	485		1
8-Aug	885	21	0.001	2181	0.974	1	486		
9-Aug	28	3	0.000	2184	0.975	1	487		
10-Aug	276	4	0.000	2188	0.977	1	488	1	
11-Aug	59	1	0.000	2189	0.977	1	489		
12-Aug	1414	43	0.002	2232	0.996	2	491	1	1
13-Aug	38	1	0.000	2233	0.997	1	492		1
14-Aug	141	0	0.000	2233	0.997		492		
15-Aug	74	2	0.000	2235	0.998	1	493		
16-Aug	185	1	0.000	2236	0.998		493		
17-Aug	200	2	0.000	2238	0.999		493		
18-Aug	594	0	0.000	2238	0.999		493		
19-Aug	662	1	0.000	2239	1.000		493		
20-Aug	133	1	0.000	2240	1.000		493		
21-Aug	21	0	0.000	2240	1.000		493		
22-Aug	464	0	0.000	2240	1.000		493		
23-Aug	697	0	0.000	2240	1.000		493		
24-Aug	231	0	0.000	2240	1.000		493		
25-Aug	367	0	0.000	2240	1.000		493		
26-Aug	470	0	0.000	2240	1.000		493		
27-Aug	152	0	0.000	2240	1.000		493		
28-Aug	401	0	0.000	2240	1.000		493		
29-Aug	159	0	0.000	2240	1.000		493		
30-Aug	134	0	0.000	2240	1.000		493		
31-Aug	302	0	0.000	2240	1.000		493		
1-Sep	492	0	0.000	2240	1.000		493		
2-Sep	113	0	0.000	2240	1.000		493		
3-Sep	439	0	0.000	2240	1.000		493		
4-Sep	105	0	0.000	2240	1.000		493		
5-Sep	57	0	0.000	2240	1.000		493		
6-Sep	236	0	0.000	2240	1.000		493		
7-Sep	495	0	0.000	2240	1.000		493		
8-Sep	163	0	0.000	2240	1.000		493		
9-Sep	519	0	0.000	2240	1.000		493		
10-Sep	892	0	0.000	2240	1.000		493		
11-Sep	244	0	0.000	2240	1.000		493		
12-Sep	27	0	0.000	2240	1.000		493		
13-Sep	271	0	0.000	2240	1.000		493		

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Date	Sockeye daily	Chinook daily	Daily Prop.	Daily Cumul.	Cumul. prop.	Sampled daily	Sampled cumul.	Tags observed	Tags sampled
14-Sep	327	0	0.000	2240	1.000		493		
15-Sep	**149**	**0**	**0.000**	**2240**	**1.000**		**493**		
16-Sep	88	0	0.000	2240	1.000		493		
17-Sep	106	0	0.000	2240	1.000		493		
18-Sep	3	0	0.000	2240	1.000		493		
19-Sep	559	0	0.000	2240	1.000		493		
20-Sep	86	0	0.000	2240	1.000		493		
21-Sep	319	0	0.000	2240	1.000		493		
22-Sep	119	0	0.000	2240	1.000		493		
23-Sep	103	0	0.000	2240	1.000		493		
24-Sep	493	0	0.000	2240	1.000		493		
25-Sep	414	0	0.000	2240	1.000		493		
26-Sep	436	0	0.000	2240	1.000		493		
27-Sep	143	0	0.000	2240	1.000		493		
28-Sep	47	0	0.000	2240	1.000		493		
29-Sep	34	0	0.000	2240	1.000		493		
30-Sep	13	0	0.000	2240	1.000		493		
1-Oct	76	0	0.000	2240	1.000		493		
2-Oct	29	0	0.000	2240	1.000		493		
3-Oct	15	0	0.000	2240	1.000		493		
4-Oct	38	0	0.000	2240	1.000		493		
5-Oct	30	0	0.000	2240	1.000		493		
6-Oct	287	0	0.000	2240	1.000		493		
7-Oct	308	0	0.000	2240	1.000		493		
8-Oct	81	0	0.000	2240	1.000		493		
9-Oct	6	0	0.000	2240	1.000		493		
10-Oct	0	0	0.000	2240	1.000		493		
11-Oct	4	0	0.000	2240	1.000		493		
12-Oct	1	0	0.000	2240	1.000		493		
13-Oct	44	0	0.000	2240	1.000		493		
14-Oct	133	0	0.000	2240	1.000		493		
15-Oct	41	0	0.000	2240	1.000		493		
16-Oct	50	0	0.000	2240	1.000		493		
Totals	25711	2240						87	49

Appendix A4.–Estimated age composition and mean length of chinook salmon in the Dry Bay set gillnet catch by sex and age class, 2002

		Brood year and age class									
		1999	1998	1998	1997	1997	1996	1996	1995	1995	
		1.1	1.2	2.1	1.3	2.2	1.4	2.3	1.5	2.4	Total
Males	n	7	62	0	187	8	73	2	0	3	342
	%	2.0	18.1		54.7	2.3	21.3	0.6	0.0	0.9	55.3
	SE of %	0.8	2.1		2.7	0.8	2.2	0.4	0.0	0.5	2.0
	Avg. length	369	551		808	573	953	950		948	
	SD length	52	58		68	67	47	14		37	
	SE length	20	7		5	24	24	6	10	21	
Females	n	0	8	0	217	1	46	4	0	1	277
	%		2.9		78.3	0.4	16.6	1.4		0.4	44.7
	SE of %		1.0		2.5	0.4	2.2	0.7		0.4	2.0
	Avg. length		619		788	595	886	884		880	
	SD length		32		44		40	47			
	SE of esc.		11		3		6	24			
Sexes combined	n	7	70	0	404	9	119	6	0	4	619
	%	1.1	11.3		65.3	1.5	19.2	1.0	0.0	0.6	100.0
	SE of %	0.4	1.3		1.9	0.5	1.6	0.4	0.0	0.3	0.0
	Avg. length	369	559		797	576	927	906		931	
	SD length	52	59		55	50.44	55	50		46	
	SE length	20	7		3	17	5	21		23	

Appendix A5.–Estimated age composition and mean length of chinook salmon in the Klukshu River, by sex and age class, 2002.

		Brood year and age class									
		1999	1998	1998	1997	1997	1996	1996	1995	1995	
		1.1	1.2	2.1	1.3	2.2	1.4	2.3	1.5	2.4	Total
Males	n	2	16		80		65	1			164
	%	1.2	9.8		48.8		39.6	0.6			42.9
	SE of %	0.9	2.3		3.9		3.8	0.6			2.5
	Avg. length	452	546		815		910	873			
	SD length	45	52		88		59				
	SE length	32	13		10		7				
Females	n	1	14		123		76	4			218
	%	0.5	6.4		56.4		34.9	1.8			57.1
	SE of %		1.7		3.4		3.2	0.9			2.5
	Avg. length	447	615		784		864	803			
	SD length		78		42		44	66			
	SE of esc.		21		4		5	33			
Sexes combined	n	3	30		203		141	5			382
	%	0.8	7.9		53.1		36.9	1.3			100.0
	SE of %	0.5	1.4		2.6		2.5	0.6			0.0
	Avg. length	451	578		797		885	817			
	SD length	32	73		66		56	65			
	SE length	19	13		5		5	29			

Appendix A6.–Estimated age composition and mean length of chinook salmon in the Blanchard and Takhanne rivers and Goat Creek, by sex and age class, 2002.

		Brood year and age class									
		1999	1998	1998	1997	1997	1996	1996	1995	1995	
		1.1	**1.2**	**2.1**	**1.3**	**2.2**	**1.4**	**2.3**	**1.5**	**2.4**	**Total**
Males	n		9		64		33	1	1		108
	%		8.3		59.3		30.6	0.9	0.9		56.8
	SE of %		2.7		4.8		4.5	0.9	0.9		3.6
	Avg. length		631		811		980	955	1020		
	SD length		85		92		52				
	SE length		28		11		9				
Females	n		1		50[a]		30	1			82
	%		1.2		61.0		36.6	1.2			43.2
	SE of %				5.4		5.4				3.6
	Avg. length		790		805		895	870			
	SD length				42		33				
	SE of esc.				6		6				
Sexes combined	n		10		114		63	2	1		190
	%		5.3		60.0		33.2	1.1	0.5		100.0
	SE of %		1.6		3.6		3.4	0.7	0.5		0.0
	Avg. length		647		808		940	913	1020		
	SD length		95		74		61	95			
	SE length		30		7		8	67			

[a] Includes one 0.4 female.

Appendix A7–Estimated age composition and mean length of chinook salmon harvested in the Dry Bay commercial set net fishery, Alsek River, by sex and age class, 2002.

		Brood year and age class									
		1999	1998	1998	1997	1997	1996	1996	1995	1995	
		1.1	**1.2**	**2.1**	**1.3**	**2.2**	**1.4**	**2.3**	**1.5**	**2.4**	**Total**
Males	n		17		21		4				42
	%		40.5		50.0		9.5				44.2
	SE of %		7.7		7.8		4.6				5.1
	Avg. length		500		821		928				
	SD Length		73		80		0				
	SE length		18		17		3				
Females	n		3[a]		46		4				53
	%		5.7		86.8		7.5				55.8
	SE of %		3.2		4.7		3.7				5.1
	Avg. length				788		872				
	SD Length				54		38				
	SE of esc.				8		19				
Sexes combined	n		20		67		8				95
	%		21.1		70.5		8.4				100.0
	SE of %		4.2		4.7		2.9				0.0
	Avg. length		500		799		894				
	SD Length		79		66		49				
	SE length		18		8		17				

APPENDIX B: RADIO TRANSMITTER DATA FROM CHINOOK SALMON TAGGED ON THE ALSEK RIVER IN 2002

Appendix B1.–Radio transmitters implanted in chinook salmon on the Alsek River in 2002, date tagged, date recorded at each tower, location during aerial surveys, and final destination.

#	Tag freq.	Tag code	Date applied	Site #1 Dry Bay	Site #2 lower Tat	Site #3 Kane Cr	Site #4 Village Cr	Site #5 Klukshu	Site #6 Takhanne	Site #7 Blanchard	Site #8 Stanley	29-Jul survey	Stock grouping (fate)	July 18 survey	June 20 survey
1	8.380	100	19-May		30-May			6-Jul	27-Jul				Klukshu	nope	
2	8.400	100	22-May		1-Jun	6-Jul		5-Jul					Klukshu		
3	8.440	100	22-May		30-May							F1	Low Fog		
4	8.460	100	25-May		11-Jun				2-Aug			T25	Lower Tats	t20	nope
5	8.480	100	25-May		21-Jun	18-Jul			24-Jul				Takhanne		
6	8.500	100	26-May		4-Jun								Lower Tats	t25	t25
7	8.520	100	27-May		2-Jun							F2	Low Fog		
8	8.540	100	28-May		4-Jun							K20	Klukshu	nope	
9	8.380	101	29-May		7-Jun	3-Jul			4-Jul	6-Jul		B20	Blanchard, upper		
10	8.400	101	29-May		12-Jun	9-Jul				13-Jul		B3	Blanchard, lower		
11	8.440	101	29-May		10-Jun							F1	Low Fog		
12	8.460	101	29-May		6-Jun	9-Jul		14-Jul				K10	Klukshu		
13	8.480	101	29-May		12-Jun	11-Jul				18-Jul		B1	Blanchard, lower		
14	8.500	101	30-May		6-Jun							F2	Low Fog		
15	8.520	101	30-May		6-Jun							T30	Lower Tats		nope
16	8.540	101	31-May		11-Jun	11-Jul			15-Jul			TK2	Takhanne		
17	8.380	102	30-May		4-Jun							K15	Klukshu	k10	
18	8.400	102	30-May		15-Jun	19-Jul			21-Jul	24-Jul		B1	Blanchard, lower		
19	8.440	102	31-May		8-Jun	8-Jul		15-Jul				K20	Klukshu		
20	8.460	102	31-May		8-Jun	8-Jul		10-Jul				K15	Klukshu		
21	8.480	102	31-May		17-Jun	18-Jul			20-Jul			TK1	Takhanne		
22	8.500	102	31-May		8-Jun				1-Jul	2-Jul	4-Jul	Goat	Goat Cr.	nope	
23	8.520	102	31-May		8-Jun							T20	Lower Tats		t25
24	8.540	102	31-May		17-Jun	14-Jul		16-Jul				K10	Klukshu		
25	8.380	103	31-May		10-Jun			9-Jul				K5	Klukshu		
26	8.400	103	31-May		12-Jun	15-Jul			16-Jul			TK2	Takhanne		
27	8.440	103	31-May		4-Jul	16-Jul			17-Jul	19-Jul		T100	Blanchard, lower		
28	8.460	103	31-May		19-Jun			7-Jul	26-Jul			T111	Takhanne		
29	8.480	103	1-Jun		15-Jun	12-Jul			14-Jul	15-Jul		B2	Blanchard, lower		
30	8.500	103	1-Jun		20-Jun							K5	Klukshu	t85	
31	8.520	103	1-Jun		19-Jun								unknown	nope	
32	8.540	103	1-Jun		9-Jun				3-Jul	6-Jul		B20	Blanchard, upper		

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#	Tag freq	Tag code	Date applied	Site #1 Dry Bay	Site #2 lower Tat	Site #3 Kane Cr	Site #4 Village Cr	Site #5 Klukshu	Site #6 Takhanne	Site #7 Blanchard	Site #8 Stanley	29-Jul survey	Stock grouping (fate)	July 18 survey	June 20 survey
33	8.380	104	1-Jun		23-Jun	17-Jul			19-Jul			TK1	Takhanne		
34	8.400	104	1-Jun		25-Jun	13-Jul			14-Jul	15-Jul		B18	Blanchard, upper		
35	8.440	104	2-Jun		10-Jun	16-Jul						F1	Low Fog		
36	8.460	104	2-Jun		8-Jun	4-Jul		7-Jul				K20	Klukshu		
37	8.480	104	2-Jun		15-Jun	13-Jul				15-Jul		B20	Blanchard, upper		
38	8.500	104	3-Jun		10-Jun	8-Jul		11-Jul				K10	Klukshu		
39	8.520	104	3-Jun		9-Jun	4-Jul		7-Jul				K5	Klukshu		
40	8.540	104	3-Jun		9-Jun	5-Jul		7-Jul			30-Jul		Klukshu		
41	8.380	105	3-Jun		9-Jun	5-Jul		10-Jul	27-Jul			K10	Klukshu		
42	8.400	105	3-Jun		20-Jun	6-Jul			13-Jul			T108	Takhanne		
43	8.440	105	3-Jun		29-Jun	3-Sep			18-Jul			TK	Takhanne		
44	8.460	105	4-Jun		19-Jun	14-Jul		15-Jul	1-Aug			K5	Klukshu		
45	8.480	105	4-Jun		16-Jun	8-Jul		11-Jul				K5	Klukshu		
46	8.500	105	4-Jun		14-Jun	6-Jul		10-Jul					Klukshu		
47	8.520	105	4-Jun		11-Jun	7-Jul		9-Jul					Klukshu		
48	8.540	105	4-Jun		17-Jun	10-Jul		13-Jul				K15	Klukshu		
49	8.380	106	4-Jun		22-Jun	13-Jul		15-Jul				K10	Klukshu		
50	8.400	106	4-Jun		20-Jun								unknown	nope	
51	8.440	106	5-Jun		12-Jun				3-Jul	5-Jul	9-Jul	Goat	Goat Cr.	nope	
52	8.460	106	5-Jun		18-Jun	14-Jul			15-Jul	17-Jul		T121	Blanchard		
53	8.480	106	5-Jun		18-Jun	11-Jul		17-Jul				T108	Klukshu		
54	8.500	106	5-Jun	6-Jun								A85	lower Tats?	a80	a30
55	8.520	106	6-Jun		28-Jun				28-Jul	29-Jul		T120	Blanchard		
56	8.540	106	6-Jun		17-Jun	9-Jul			14-Jul			TK2	Takhanne		
57	8.380	107	6-Jun		16-Jun	12-Jul		15-Jul				K10	Klukshu		
58	8.400	107	6-Jun		24-Jun	18-Jul			20-Jul			TK3	Takhanne		
59	8.440	107	7-Jun		19-Jun	10-Jul		10-Jul					Upper Tats		
60	8.460	107	6-Jun		18-Jun				3-Jul	5-Jul	8-Jul	Goat	Goat Cr.	nope	
61	8.480	107	6-Jun		16-Jun							F1	Low Fog		
62	8.500	107	6-Jun		24-Jun	17-Jul				20-Jul		B6	Blanchard, lower		
63	8.520	107	6-Jun		14-Jun	10-Jul							Upper Tats		T40
64	8.540	107	6-Jun		24-Jun							T55	Lower Tats		nope
65	8.380	108	6-Jun		21-Jun	7-Jul			13-Jul			T109	Takhanne		
66	8.400	108	7-Jun		28-Jun	18-Jul				21-Jul		B14	Blanchard, upper		
67	8.440	108	7-Jun										Mortality	nope	nope

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#	Tag freq	Tag code	Date applied	Site #1 Dry Bay	Site #2 lower Tat	Site #3 Kane Cr	Site #4 Village Cr	Site #5 Klukshu	Site #6 Takhanne	Site #7 Blanchard	Site #8 Stanley	29-Jul survey	Stock grouping (fate)	July 18 survey	June 20 survey
68	8.460	108	7-Jun		20-Jun	17-Jul		6-Aug	29-Jul			TK2	Takhanne		
69	8.480	108	7-Jun		15-Jun	3-Jul			4-Jul	6-Jul			Blanchard		
70	8.500	108	7-Jun		25-Jun							T25	Lower Tats		nope
71	8.520	108	7-Jun		20-Jun					23-Jul		B5	Blanchard, lower		
72	8.540	108	7-Jun		26-Jun	19-Jul			29-Jul			TK2	Takhanne		
73	8.380	109	7-Jun		28-Jun							T108	Upper Tats	nope	nope
74	8.400	109	8-Jun		16-Jun							F2	Low Fog		
75	8.440	109	8-Jun		caught Dry Bay								Dry Bay gillnet		
76	8.460	109	8-Jun		16-Jun	9-Jul				11-Jul		B20	Blanchard, upper		
77	8.480	109	8-Jun		20-Jun							T40	Lower Tats		nope
78	8.500	109	8-Jun		2-Jul	16-Jul			16-Jul			Goat	Goat Cr.	t140	
79	8.520	109	25-Jun		11-Jul	7-Aug			9-Aug	11-Aug		T75	Blanchard	t30	
80	8.540	109	8-Jun		19-Jun	13-Jul		18-Jul				K15	Klukshu		
81	8.380	110	9-Jun		21-Jun	16-Jul							Upper Tats	nope	
82	8.400	110	9-Jun		24-Jun							F1	Low Fog		
83	8.440	110	9-Jun		26-Jun							T98	Upper Tats	T110	
84	8.460	110	9-Jun										Dry Bay gillnet		
85	8.480	110	9-Jun		21-Jun	14-Jul		22-Jul					Klukshu		
86	8.500	110	9-Jun		27-Jun							F1	Low Fog		
87	8.520	110	9-Jun		19-Jun	13-Jul			16-Jul			TK	Takhanne		
88	8.540	110	9-Jun		22-Jun	13-Jul			14-Jul	17-Jul		B20	Blanchard, upper		
89	8.380	111	9-Jun		caught Dry Bay								Dry Bay gillnet		
90	8.400	111	9-Jun		25-Jun			6-Aug				T105	Klukshu		
91	8.440	111	9-Jun		26-Jun	19-Jul		21-Jul				K15	Klukshu		
92	8.460	111	10-Jun		caught Dry Bay								Dry Bay gillnet		
93	8.480	111	9-Jun		17-Jun		25-Jul						Village Cr.	t110	
94	8.500	111	9-Jun		24-Jun	15-Jul		7-Aug	16-Jul	18-Jul		B6	Blanchard, lower		
95	8.520	111	10-Jun		24-Jun	13-Jul		15-Jul					Klukshu		
96	8.540	111	10-Jun	9-Jun								A85	lower Tats?	a80	a85
97	8.380	112	10-Jun		25-Jun							T20	Lower Tats		nope
98	8.400	112	10-Jun		27-Jun					26-Jul		B5	Blanchard, lower		
99	8.440	112	10-Jun		caught in Dry Bay								Dry Bay gillnet		
100	8.460	112	10-Jun		1-Jul			22-Jul					Klukshu	nope	
101	8.480	112	10-Jun		24-Jun	16-Jul		17-Jul					Klukshu		
102	8.500	112	10-Jun	9-Jun								A85	lower Tats?	a80	nope

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#	Tag freq	Tag code	Date applied	Site #1 Dry Bay	Site #2 lower Tat	Site #3 Kane Cr	Site #4 Village Cr	Site #5 Klukshu	Site #6 Takhanne	Site #7 Blanchard	Site #8 Stanley	29-Jul survey	Stock grouping (fate)	July 18 survey	June 20 survey
103	8.520	112	10-Jun		22-Jun							T25	Lower Tats		nope
104	8.540	112	10-Jun		28-Jun							T20	Lower Tats		a85
105	8.380	113	10-Jun		18-Jun	10-Jul							Upper Tats	nope	
106	8.400	113	10-Jun		26-Jun	16-Jul				20-Jul			Blanchard		
107	8.440	113	11-Jun		22-Jun	18-Jul			29-Jul			TK	Takhanne		
108	8.460	113	11-Jun	12-Jun									Mortality	nope	nope
109	8.480	113	11-Jun		27-Jun							K10	Klukshu	nope	t5
110	8.500	113	23-Jun									A85	lower Tats?	nope	nope
111	8.520	113	11-Jun		22-Jun	19-Jul				21-Jul		B20	Blanchard, upper		
112	8.540	113	11-Jun		28-Jun	17-Jul						K20	Klukshu	t120	
113	8.380	114	11-Jun		28-Jun	1-Aug			2-Aug			T100	Takhanne		
114	8.400	114	11-Jun		caught Dry Bay								Dry Bay gillnet		
115	8.440	114	12-Jun										lower Tats?	nope	a60
116	8.460	114	12-Jun		22-Jun	10-Jul				14-Jul		B20	Blanchard, upper		
117	8.480	114	12-Jun		25-Jun			14-Jul					Klukshu		
118	8.500	114	12-Jun		28-Jun							K20	Klukshu	t125	
119	8.520	114	12-Jun		23-Jun								unknown	klukshu	a70
120	8.540	114	12-Jun		27-Jun					25-Jul			Blanchard		
121	8.380	115	12-Jun		21-Jun	7-Jul						T135	Upper Tats	t150	
122	8.400	115	12-Jun		27-Jun	18-Jul						TK2	Takhanne	t120	
123	8.440	115	12-Jun		26-Jun							K5	Klukshu	t125	
124	8.460	115	12-Jun		30-Jun					27-Jul		B1	Blanchard, lower		
125	8.480	115	12-Jun		23-Jun							T128	Upper Tats	t125	
126	8.500	115	13-Jun		29-Jun							T25	Lower Tats		nope
127	8.520	115	13-Jun		27-Jun	3-Sep						T104	Upper Tats	t80	
128	8.540	115	13-Jun		4-Jul	31-Jul			1-Aug			T80	Takhanne		
129	8.380	116	13-Jun		30-Jun					23-Jul		B10	Blanchard, upper		
130	8.400	116	13-Jun		25-Jun			14-Jul					Klukshu		
131	8.440	116	13-Jun		25-Jun	7-Jul				9-Jul		B7	Blanchard, lower		
132	8.460	116	13-Jun		28-Jun					30-Jul		T135	Blanchard		
133	8.480	116	13-Jun		24-Jun				14-Jul	11-Jul		T140	Upper Tats	t150	
134	8.500	116	13-Jun		1-Jul	18-Jul				21-Jul		B7	Blanchard, lower		
135	8.520	116	13-Jun		29-Jun							T50	Lower Tats		t5
136	8.540	116	13-Jun		24-Jun								unknown	nope	a70
137	8.380	117	13-Jun		1-Jul							K15	Klukshu	nope	A40

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#	Tag freq	Tag code	Date applied	Site #1 Dry Bay	Site #2 lower Tat	Site #3 Kane Cr	Site #4 Village Cr	Site #5 Klukshu	Site #6 Takhanne	Site #7 Blanchard	Site #8 Stanley	29-Jul survey	Stock grouping (fate)	July 18 survey	June 20 survey
138	8.400	117	13-Jun		1-Jul							TK2	Takhanne	t85	
139	8.440	117	13-Jun		28-Jun							T75	Middle Tats	t80	nope
140	8.460	117	13-Jun		25-Jun							K5	Klukshu	t120	
141	8.480	117	13-Jun		4-Jul							Goat	Goat Cr.	nope	t5
142	8.500	117	13-Jun		14-Jul							A70	Lower Tats		nope
143	8.520	117	14-Jun	13-Jun								A70	lower Tats?	A115	a35
144	8.540	117	14-Jun		1-Jul				1-Aug	3-Aug			Blanchard		
145	8.380	118	14-Jun		26-Jun							T25	Lower Tats		nope
146	8.400	118	14-Jun		24-Jun	6-Jul		9-Jul				K20	Klukshu		
147	8.440	118	14-Jun		23-Jun	10-Jul		15-Jul				T108	Klukshu		
148	8.460	118	14-Jun		24-Jun								unknown	nope	nope
149	8.480	118	14-Jun		30-Jun					28-Jul		B2	Blanchard, lower		
150	8.500	118	15-Jun		26-Jun							T25	Lower Tats		nope
151	8.520	118	15-Jun		26-Jun	20-Jul				22-Jul			Blanchard		
152	8.540	118	15-Jun		24-Jun							K15	Klukshu	k1	
153	8.380	119	15-Jun		23-Jun	7-Jul		9-Jul				K10	Klukshu		
154	8.400	119	15-Jun		23-Jun	6-Jul				11-Jul		B20	Blanchard, upper		
155	8.440	119	15-Jun	27-Jun									Mortality	nope	nope
156	8.460	119	15-Jun		3-Jul	2-Aug			3-Aug	5-Aug		T89	Blanchard		
157	8.480	119	15-Jun		29-Jun	18-Jul					30-Jul		Klukshu	t120	
158	8.500	119	16-Jun		23-Jun				14-Jul			TK2	Takhanne		
159	8.520	119	16-Jun		25-Jun	11-Jul		16-Jul				K5	Klukshu		
160	8.540	119	16-Jun		24-Jun	11-Jul				15-Jul		B20	Blanchard, upper		
161	8.380	120	16-Jun		30-Jun					29-Jul		T121	Blanchard		
162	8.400	120	16-Jun		5-Jul							T108	Upper Tats	t40	
163	8.440	120	16-Jun		30-Jun							T130	Upper Tats	t85	
164	8.460	120	16-Jun		28-Jun	31-Jul		15-Jul				K5	Klukshu		
165	8.480	120	17-Jun		2-Jul								unknown	nope	nope
166	8.500	120	17-Jun		2-Jul			30-Jul				T108	Klukshu		
167	8.520	120	17-Jun		26-Jun				16-Jul			TK1	Takhanne		
168	8.540	120	18-Jun		29-Jun	30-Jul						T104	Upper Tats	t80	
169	8.380	121	18-Jun		28-Jun	17-Jul						K20	Klukshu	t120	
170	8.400	121	18-Jun										Mortality	nope	nope
171	8.440	121	18-Jun		6-Jul	31-Jul			31-Jul	1-Aug		T80	Blanchard		
172	8.460	121	18-Jun		29-Jun			31-Jul					Klukshu	nope	

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#	Tag freq	Tag code	Date applied	Site #1 Dry Bay	Site #2 lower Tat	Site #3 Kane Cr	Site #4 Village Cr	Site #5 Klukshu	Site #6 Takhanne	Site #7 Blanchard	Site #8 Stanley	29-Jul survey	Stock grouping (fate)	July 18 survey	June 20 survey
173	8.480	121	19-Jun		30-Jun				29-Jul			TK1	Takhanne		
174	8.500	121	19-Jun		26-Jun				13-Jul	15-Jul		B2	Blanchard, lower		
175	8.520	121	20-Jun		28-Jun	17-Jul						T104	Upper Tats	t120	
176	8.540	121	20-Jun		28-Jun					24-Jul		B2	Blanchard, lower		
177	8.380	122	21-Jun		30-Jun			1-Aug					unknown	nope	nope
178	8.400	122	21-Jun		1-Jul				15-Jul	17-Jul			Blanchard		
179	8.440	122	21-Jun		3-Jul	31-Jul		1-Aug				T80	Klukshu		
180	8.460	122	21-Jun		29-Jun					19-Jul			Blanchard		
181	8.480	122	22-Jun										Mortality	nope	nope
182	8.500	122	22-Jun		4-Jul			1-Aug				T108	Klukshu		
183	8.520	122	22-Jun		4-Jul							K15	Klukshu	nope	
184	8.540	122	1-Jul										unknown	a75	nope
185	8.380	123	23-Jun		8-Jul					30-Jul		T100	Blanchard		
186	8.400	123	24-Jun		4-Jul	1-Aug		2-Aug				T89	Klukshu		
187	8.440	123	24-Jun		5-Jul			1-Aug					lower Tats?	t50	nope
188	8.460	123	25-Jun		5-Jul					1-Aug			Blanchard		
189	8.480	123	26-Jun		2-Jul	18-Jul						K20	Klukshu	nope	
190	8.500	123	30-Jun		13-Jul				10-Aug			T45	Takhanne		
191	8.520	123	29-Jun		9-Jul							K10	Klukshu	t50	
192	8.540	123	2-Jul										Mortality	nope	nope
193	8.380	124	2-Jul		7-Jul							F2	Low Fog		
194	8.400	124	2-Jul		13-Jul	1-Aug			7-Aug			T98	Takhanne		
195	8.440	124	2-Jul		18-Jul								Lower Tats	t10	nope

APPENDIX C: DETECTION OF SIZE SELECTIVITY

Appendix C1.–Detection of size-selectivity in sampling and its effects on estimation of size composition.

Results of hypothesis tests (K-S and χ^2) on lengths of fish MARKED during the first event and RECAPTURED during the second event	Results of hypothesis tests (K-S) on lengths of fish MARKED during the first event and INSPECTED during the second event
Case I	
"Accept H_o"	"Accept H_o"
There is no size-selectivity during either event	
Case II	
"Accept H_o"	"Reject H_o"
There is no size-selectivity during the second sampling event but there is during the first	
Case III	
"Reject H_o"	"Accept H_o"
There is size-selectivity during both sampling events	
Case IV	
"Reject H_o"	"Reject H_o"
There is size-selectivity during the second sampling event; the status of size-selectivity during the first event is unknown	

Case I: Calculate one unstratified abundance estimate and pool lengths, sexes, and ages from both sampling events to improve precision of proportions in estimates of composition.

Case II: Calculate one unstratified abundance estimate and only use lengths, sexes, and ages from the second sampling event to estimate proportions in compositions.

Case III: Completely stratify both sampling events and estimate abundance for each stratum. Add abundance estimates across strata to get a single estimate for the population. Pool lengths, sexes, and ages from both sampling events to improve precision of proportions in estimates of composition, and apply formulae to correct for size bias to the pooled data.

Case IV: Completely stratify both sampling events and estimate abundance for each stratum. Add abundance estimates across strata to get a single estimate for the population. Use lengths, sexes, and ages from only the second sampling event to estimate proportions in compositions, and apply formulae to correct for size bias to the data from the second sampling event.

Whenever the results of the hypothesis tests indicate that there has been size-selective sampling (Case III or IV), there is still a chance that the bias in estimates of abundance from this phenomenon is negligible. Produce a second estimate of abundance by not stratifying the data as recommended above. If the two estimates (stratified and unbiased vs. biased and unstratified) are dissimilar, the bias is meaningful, the stratified estimate should be used, and data on compositions should be analyzed as described above for Case III or IV. However, if the two estimates of abundance are similar, the bias is negligible in the UNSTRATIFIED estimate, and the analysis can proceed as if there were no size-selective sampling during the second event (Case I or II).

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Case III or IV: Size-selective sampling in both sampling events

n_i	Number of unique fish sampled during **SECOND** event **ONLY** within stratum *i*
n_{ij}	Number of unique fish of age *j* sampled during the **SECOND** event **ONLY** within stratum *i*
$\hat{p}_{ij} = \dfrac{n_{ij}}{n_i}$	Estimated fraction of fish of age *j* in stratum *i*. Note that $\sum_j \hat{p}_{ij} = 1$
$v(\hat{p}_{ij}) = \dfrac{\hat{p}_{ij}(1-\hat{p}_{ij})}{n_i - 1}$	An unbiased of variance [1]
$\hat{N}_i$	Estimated abundance in stratum *i* from the mark-recapture experiment
$\hat{N}_j = \sum_i (\hat{p}_{ij}\hat{N}_i)$	Estimated abundance of fish in age group *j* in the population
$v(\hat{N}_j) = \sum_i (v(\hat{p}_{ij})\hat{N}_i^2 + v(\hat{N}_i)\hat{p}^2{}_{ij} - v(\hat{p}_{ij})v(\hat{N}_i))$	An unbiased estimate of variance [2]
$\hat{p}_j = \dfrac{\hat{N}_j}{\sum_i \hat{N}_i} = \dfrac{\hat{N}_j}{\hat{N}}$	Estimated fraction of fish in age group *j* in the population
$v(\hat{p}_j) = \dfrac{\sum_i (v(\hat{p}_{ij})\hat{N}_i^2 + v(\hat{N}_i)(\hat{p}_{ij} - \hat{p}_j)^2)}{\hat{N}^2}$	An approximate estimate of variance [3]

[1] Page 52 *in* Cochran, W. G. 1977. Sampling techniques, third edition. John Wiley and Sons, Inc. New York.

[2] From methods in Goodman, L. G. 1960. On the exact variance of a product. Journal of the American Statistical Association.

[3] From the delta method, page 8 *in* Seber, G. A. F. 1982. The estimation of animal abundance and related parameters, second edition. Charles Griffin and Company, Ltd. London.

Appendix C2.–Procedures used in estimating the abundance of small and medium chinook salmon in the escapement to the Alsek River, 2002.

The estimated number of small chinook salmon $\hat{N}_{sm}$ in the population was calculated as a product of the number of large salmon $\hat{N}_{la}$ estimated through the mark-recapture experiment and an expansion factor $\hat{\theta}$ estimated through sampling to estimate relative size composition of the population:

$$\hat{N}_{sm} = \hat{N}_{la}\hat{\theta}$$

The estimated expansion was calculated as a ratio of two estimated, dependent fractions: $\hat{p}_{sm}$ represents small salmon and $\hat{p}_{la}$ large salmon:

$$\hat{\theta} = \hat{p}_{sm} / \hat{p}_{la}$$

The first step in the calculations to estimate variance involved the variance for the estimated expansion factor. From the delta method (see Seber 1982:7-9):

$$v(\hat{\theta}) \cong \hat{\theta}^2 \left[\frac{v(\hat{p}_{sm})}{\hat{p}_{sm}^2} + \frac{v(\hat{p}_{sm})}{\hat{p}_{la}^2} - \frac{2cov(\hat{p}_{sm}, (\hat{p}_{sm})}{\hat{p}_{sm}\hat{p}_{la}} \right]$$

When substituted into the equation above, the following relationships:

$$v(\hat{p}) \cong \frac{\hat{p}(1-\hat{p})}{n} \qquad cov(\hat{p}_{sm}, \hat{p}_{la}) \cong -\frac{\hat{p}_{sm}\hat{p}_{la}}{n}$$

simplify the calculation to:

$$v(\hat{\theta}) \cong \hat{\theta}^2 \left[\frac{1}{n\hat{p}_{sm}} + \frac{1}{n\hat{p}_{la}} \right]$$

where n is the size of the sample taken to estimate relative size of the population.

The final step in the calculations to estimate the variance of $\hat{N}_{sm}$ follows the method of Goodman (1960) for estimating the exact variance of a product:

$$v(\hat{N}_{sm}) = \hat{N}_{la}^2 v(\hat{\theta}) + \hat{\theta}^2 v(\hat{N}_{la}) - v(\hat{\theta}) v(\hat{N}_{la})$$

No covariance was involved in the above equation because both variates ($\hat{N}_{sm}$ and $\hat{\theta}$) were derived from independent programs.

APPENDIX D: COMPUTER FILES USED IN THIS REPORT

Appendix D1.–Computer files used to estimate the spawning abundance and distribution of chinook salmon in the Alsek River, 2002.

File name	Description
2002 Alsek Mark-recap effort.XLS	EXCEL spreadsheet with gillnet tagging data--daily effort, catch by species, and water depth by site; gillnet charts.
Alsek02.XLS	Age, sex, length (ASL) data from tagging site.
spawning ground ages 2002.XLS	Age, sex, length (ASL) data from spawning ground samples
KS_tests.XLS	KS tests
Kscharts02.XLS	cumulative relative frequency charts and data
Klukshu ages 2002.XLS	Klukshu weir tags and ASL data
Tower & aerial survey 2002 chinook.XLS	Telemetry data summary